High-bandwidth Digital Content Protection Protocol Analyzer

UITA-2000

Universal Interoperability-Testing Analyzer

Operation Manual

(Updated for HDCP CTS v1.2)

Preliminary / CONFIDENTIAL

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Preface

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Document Revision History

Revision	Data	Comment
2.0.0.01	December, 2009	Update for HDCP CTS v1.2 except CP&EDID_HPD related testing

1.SCOPE

This document provides the operation information for the use of HDCP Protocol Analyzer UITA-2000.

All information described in this document is subject to change without notice.

2. GENERAL

The HDCP Protocol Analyzer is designed for testing whether a HDMI-capable Source/Sink/Repeater device is compliant with the High-bandwidth Digital Content Protection System 1.4.

3. Transmitter Test for Source Device

'HDCPTestTool.exe' and UITA-2000 emulate for the Sink/Repeater function as Test Equipment (TE) and perform Transmitter Test for Source (DUT).

3.1. Test Items

The Transmitter Test (downstream) has the following test items:

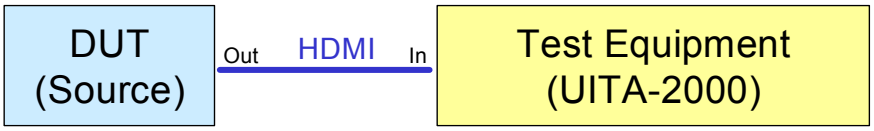
The tool functions as Sink		
1A-01	Regular	Procedure with Receiver
	Verification test for the procedure which Source performs the first part and the third part of the authentication with HDMI-capable Sink	
1A-02	Regular	HDCP_HPD after writing Aksv
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink de-asserts and asserts HDCP_HPD after receiving the write-access of Aksv	
1A-03	Regular	HDCP_HPD after starting 3rd authe
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink de-asserts and asserts HDCP_HPD during the third part of authentication	
1A-04	Irregular	HDCP port access
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink does not respond to HDCP port access	
1A-05	Irregular	Read Ksv
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink has the invalid Bksv value (all 0)	
1A-06	Irregular	Verify R0'
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink sets the invalid R0' value in the first part of the authentication	
1A-07	Irregular	Verify Ri'
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink sets the invalid Ri' value in the third part of the authentication	
1A-07a	Irregular	Verify return of Ri'
	Verification test for the procedure which Source performs with HDMI-capable Sink when Ri' is not returned by the Sink	
1A-08	Irregular	SRM
	Verification test for the procedure which Source performs with HDMI-capable Sink when Sink has the invalid Bksv value listed in the SRM	

1A-09	Regular	Procedure with DVI Receiver
	Verification test for the procedure which Source performs the first part and the third part of the authentication with DVI Sink	
The tool functions as Repeater		
1B-01	Regular	Procedure with Repeater
	Verification test for the procedure which Source performs the first part, the second part and the third part of the authentication with Repeater	
1B-02	Regular	HDCP_HPD after reading R0’
	Verification test for the procedure which Source performs with Repeater when Repeater de-asserts and asserts HDCP_HPD after receiving the read-access of R0’	
1B-03	Irregular	Timeout of KSV list READY
	Verification test for the procedure which Source performs with Repeater when Repeater does not set READY bit of Bcaps in the second part of authentication	
1B-04	Irregular	Verify V'
	Verification test for the procedure which Source performs with Repeater when Repeater sets the invalid V’ value in the second part of the authentication	
1B-05	Irregular	MAX_DEVS_EXCEEDED
	Verification test for the procedure which Source performs with Repeater when Repeater sets MAX_DEVS_EXCEEDED bit of Bstatus in the second part of authentication	
1B-06	Irregular	MAX_CASCADE_EXCEEDED
	Verification test for the procedure which Source performs with Repeater when Repeater sets MAX_CASCADE_EXCEEDED bit of Bstatus in the second part of authentication	

3.2. Test Operation

Connection Setup for Test

- ☐ Connect TE to the downstream HDCP-protected Interface Port of DUT.



(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

(2) Turn on DUT (Source).

(3) Set DUT's output to HDMI.

(4) Configure DUT to output one of the following video format timing.

- 640x480p@59.94/60Hz, RGB
- 720x480p@59.94/60Hz, RGB (RECOMMENDED)
- 720x576p@50Hz, RGB

■ Some DUT might need a display device to show the menu for setting the picture resolution. In that case, use another Sink device (display) in order to set DUT's HDMI output video format timing before testing.

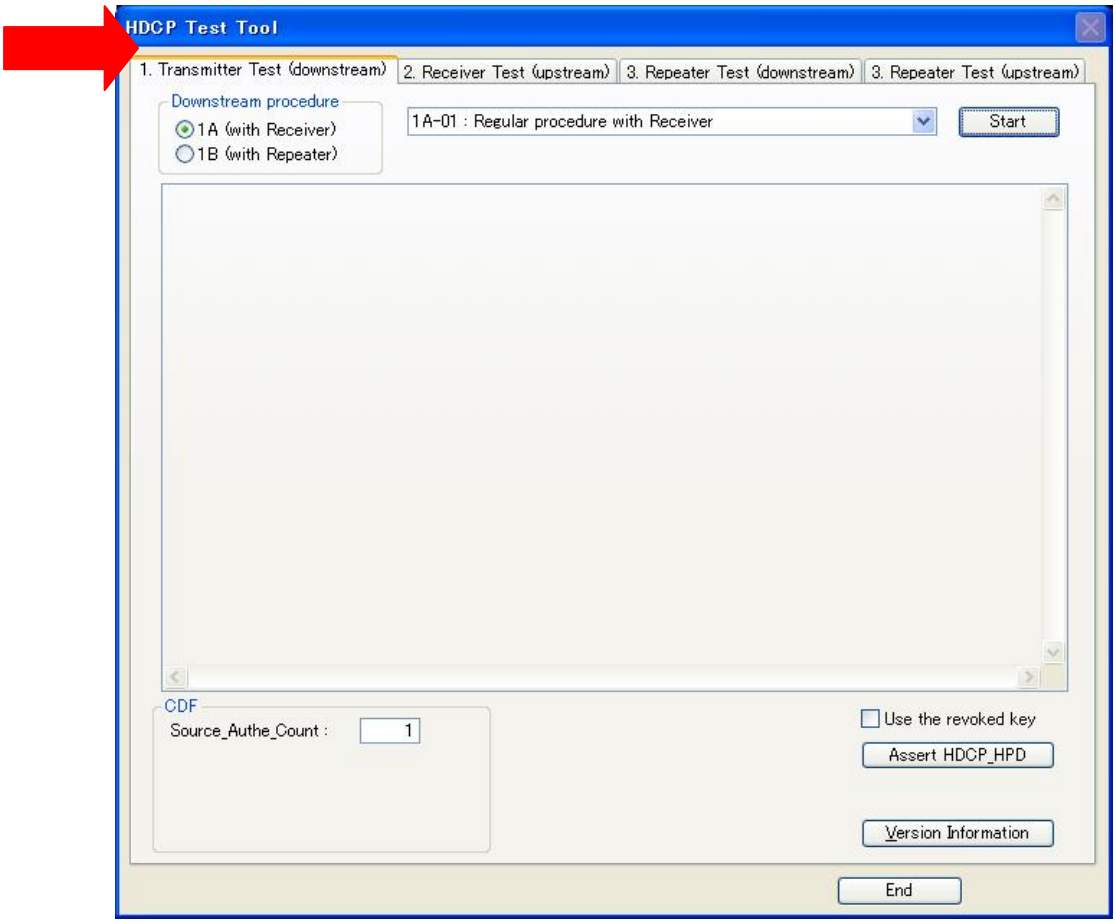
(5) Make DUT to start outputting the protected content.

*** As for "1A-08" test, the specified DVD test disc shall be used to playback.**

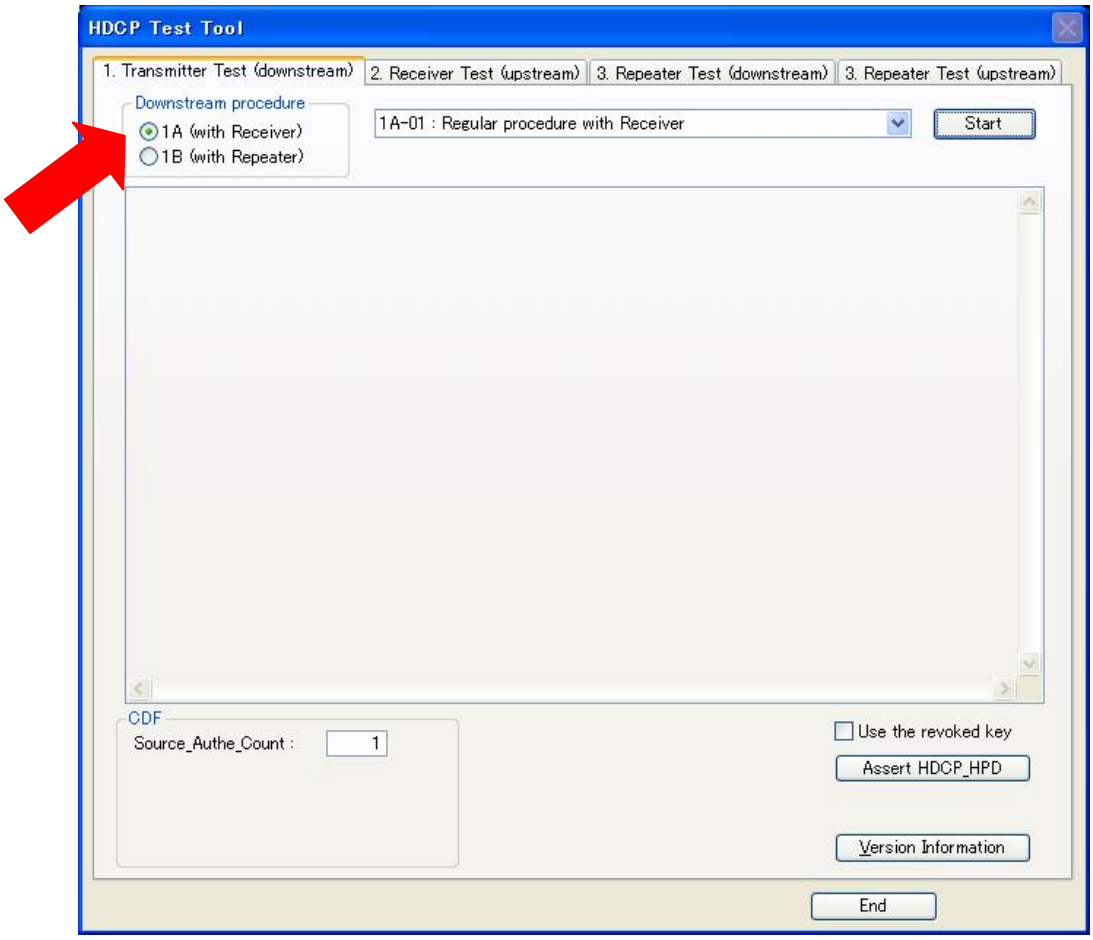
(6) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of DUT to "HDMI IN" connecter of TE)

Verification Test of the authentication procedure

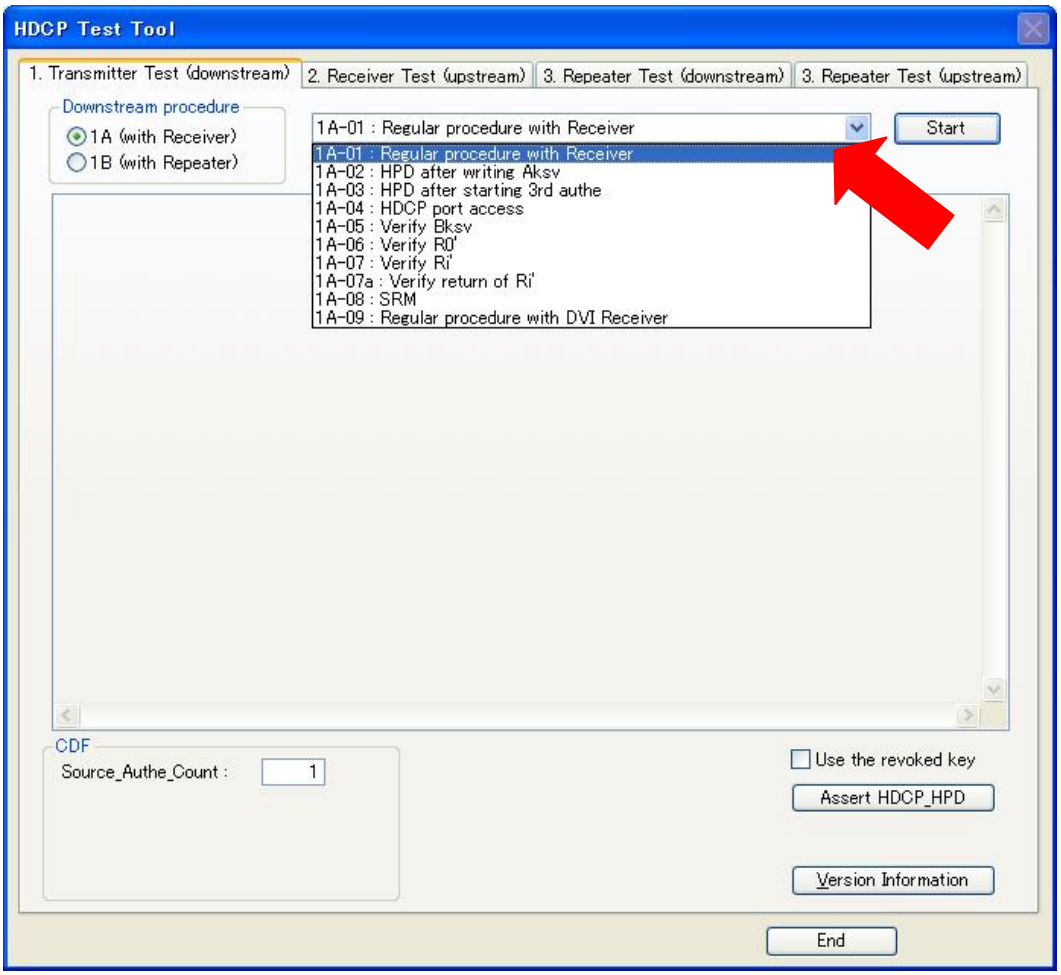
(7) Start 'HDCPTestTool.exe' by double-clicking it on PC and display "1. Transmitter Test (downstream)" window.



(8) Select one of the functions of the tool as for “Downstream procedure”, “1A (with Receiver)” or “1B (with Repeater)”.

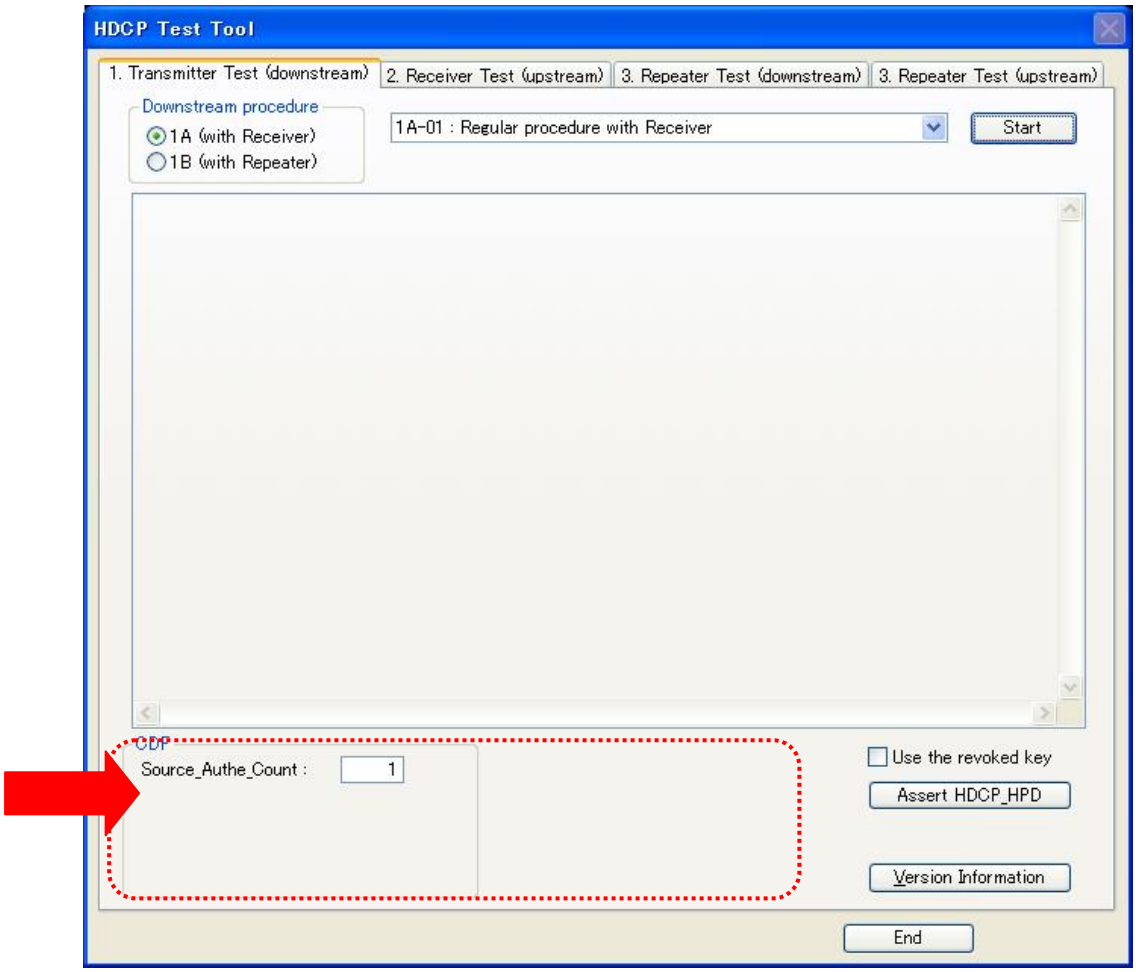


(9) Select the test item by selecting the corresponding test-ID.



(10) Input the necessary setting for the test.

The each test is performed on the basis of the information input by the operator.



Input Parameter list

Product Capability Parameter (PCP)

(a) "Source_Authe_Count" = How many times does DUT perform the authentication in order to go into and stay in the authenticated state? The "Source_Authe_Count" number of authentication is verified. Input the number from 1 to 10.

(b) "Source_Max_KSV" = Maximum number of downstream devices listed in KSV list which DUT supports. i.e. The size of KSV FIFO in bytes divided by 5 which the source can read. Input the number from 1 to 127.

(c) "Source_CP&EDID_HPD" = Does DUT provide HDMI support for CP&EDID_HPD signal as specified in the HDMI1.4 specification?

Note: The input of this parameter is disabled in HDCPTestTool.exe ver2.0.0.0X. Therefore "Source_CP&EDID_HPD" is always set to "No".

Others

If (c) "Source_CP&EDID_HPD" is checked, either of the following should be selected. Both test cases must be run. If (c) "Source_CP&EDID_HPD" is not checked, only (d) "Physical HPD line" can be selected.

(d) "Physical HPD line" = HDCP_HPD maps to physical HPD line.

(e) "CP&EDID HPD signal" = HDCP_HPD maps to CP&EDID signal.

Note: Since the input of "Source_CP&EDID_HPD" is disabled in HDCPTestTol.exe ver2.0.0.0X, "Physical HPD line" is always selected.

(f) "DEVICE_COUNT = 0" = TE acts as a Repeater with its Bstatus:DEVICE_COUNT value is zero.

(g) "DEVICE_COUNT != 0" = TE acts as a Repeater with its Bstatus:DEVICE_COUNT value is not zero.

(h) "Use the revoked key" = Does TE use the revoked key which is listed on the DVD test disc for "1A-08" test? If Yes, check this.

This is only used for your information. If DUT fails in "1A-08" test by continuing the third part of authentication, you can check whether DUT actually outputs the content or not in the encrypted frames, by performing 1A-01 test to view whether the image is displayed or not by setting "Use the revoked key" = Yes.

O = Operator needs to input

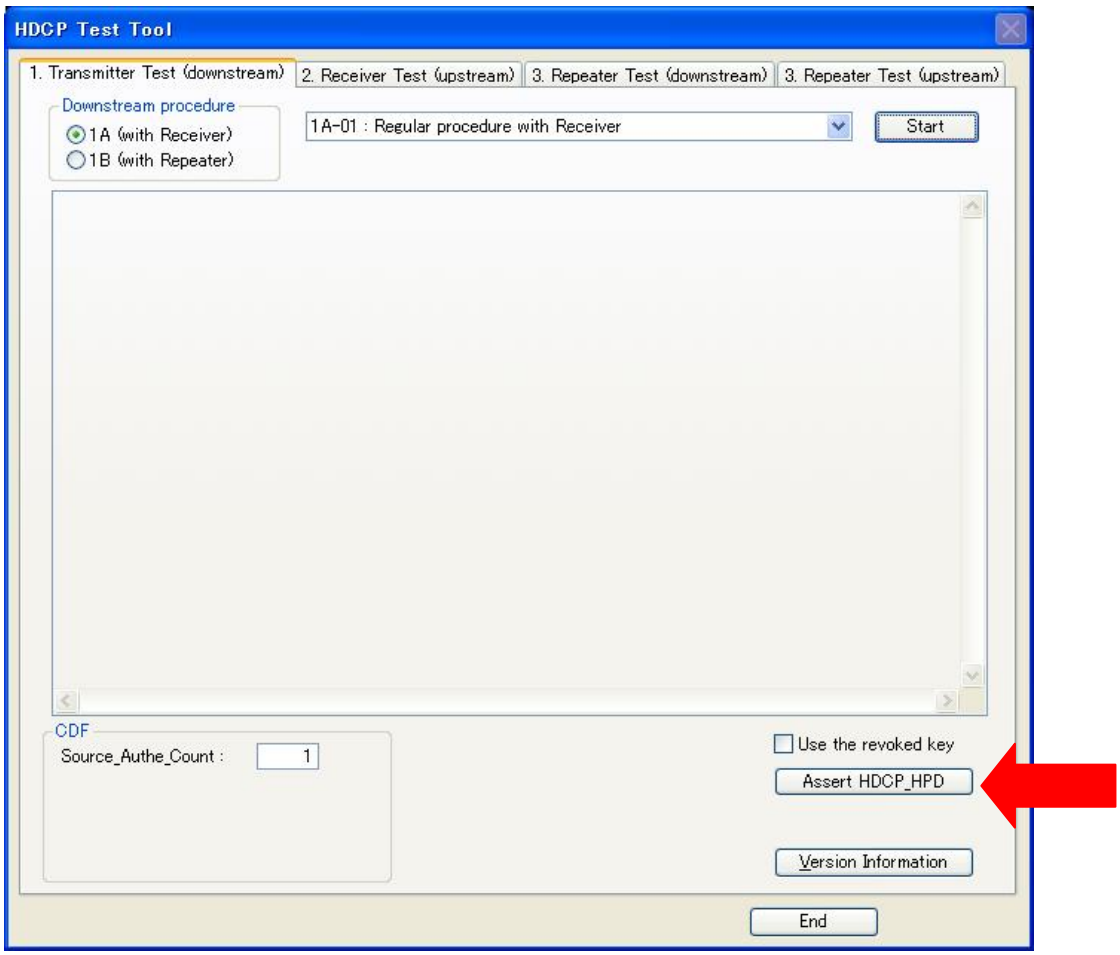
Test ID	(a)	(b)	(c)	(d)	(e)	(f)/(g)	(h)
1A -01	O	-	-	-	-	-	O
1A -02	O	-	O	O	O	-	-
1A -03	-	-	O	O	O	-	-
1A -04	-	-	-	-	-	-	-
1A -05	O	-	-	-	-	-	-
1A -06	O	-	-	-	-	-	-
1A -07	-	-	-	-	-	-	-
1A -07a	-	-	-	-	-	-	-
1A -08	O	-	-	-	-	-	-
1A -09	O	-	-	-	-	-	-
1B -01	O	O	-	-	-	O	-
1B -02	O	-	O	O	O	-	-
1B -03	O	-	-	-	-	-	-
1B -04	O	O	-	-	-	O	-
1B -05	O	-	-	-	-	-	-
1B -06	O	-	-	-	-	-	-

On the basis of value of (b) “Source_Max_KSV”, TE as Pseudo-Repeater configures its setting of Bstatus:DEPTH and DEVICE_COUNT as follows:

Test ID	DEPTH	DEVICE_COUNT
1B -01	6 or fewer	127 or fewer
1B -02	1	1
1B -03	1	1
1B -04	6 or fewer	6 or fewer
1B -05	1	1
1B -06	1	1

(11) Click “Start” button. Select/create the filename and folder to save the LOG and push “Save” button to continue.

- **Before starting the test, make sure to unplug and plug HDMI connecter especially if you switch the test item between 1A-09 and the others. It may be necessary for some DUT.**
- When UITA-2000 (hardware) is powered on, it is in the following status:
  (a) HDCP_HPD (physical HPD line) is de-asserted and HDCP register is disabled
- When HDCP_HPD (physical HPD line) is necessary to be asserted before starting test, click “Assert HDCP_HPD” button.

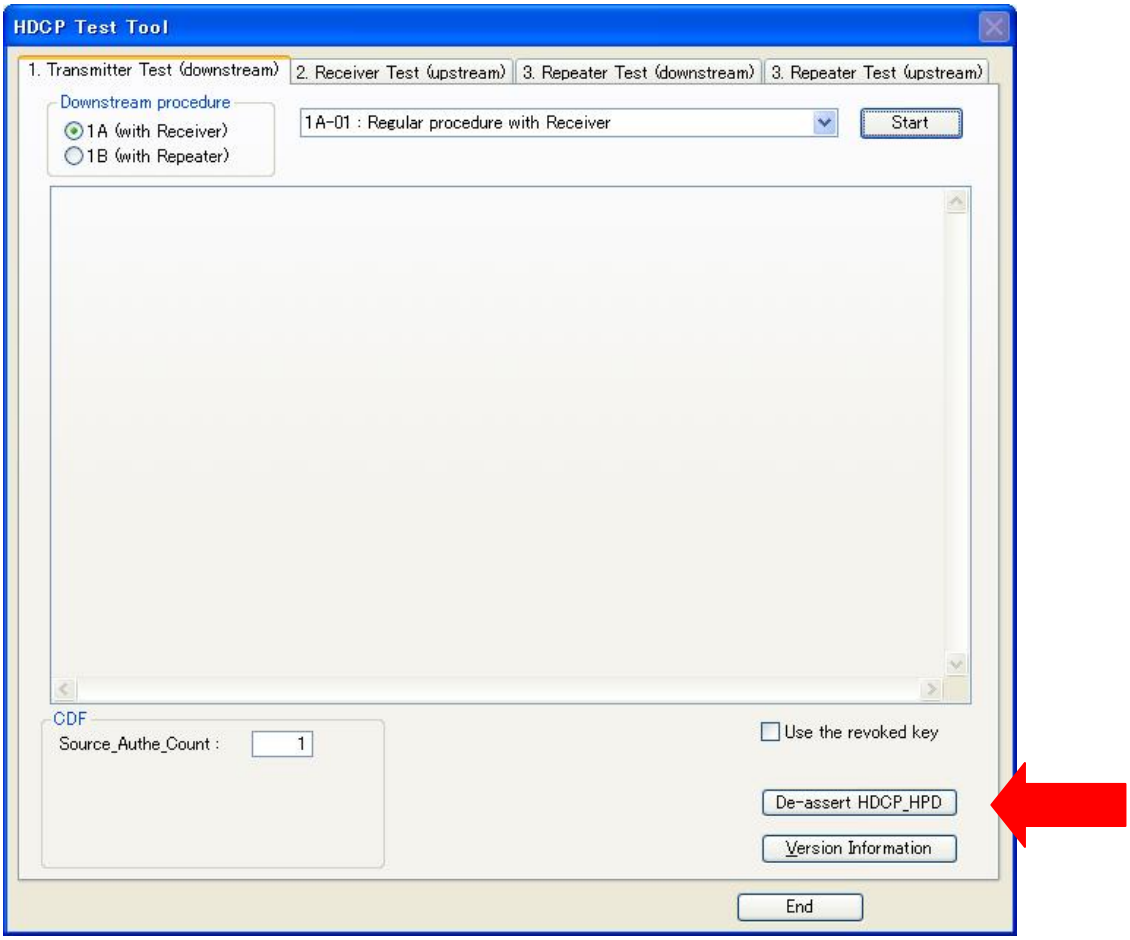


Note: When HDCPTestTool.exe is started, “Assert HDCP_HPD” button is always valid regardless of the actual HDCP_HPD status of UITA-2000 (hardware).

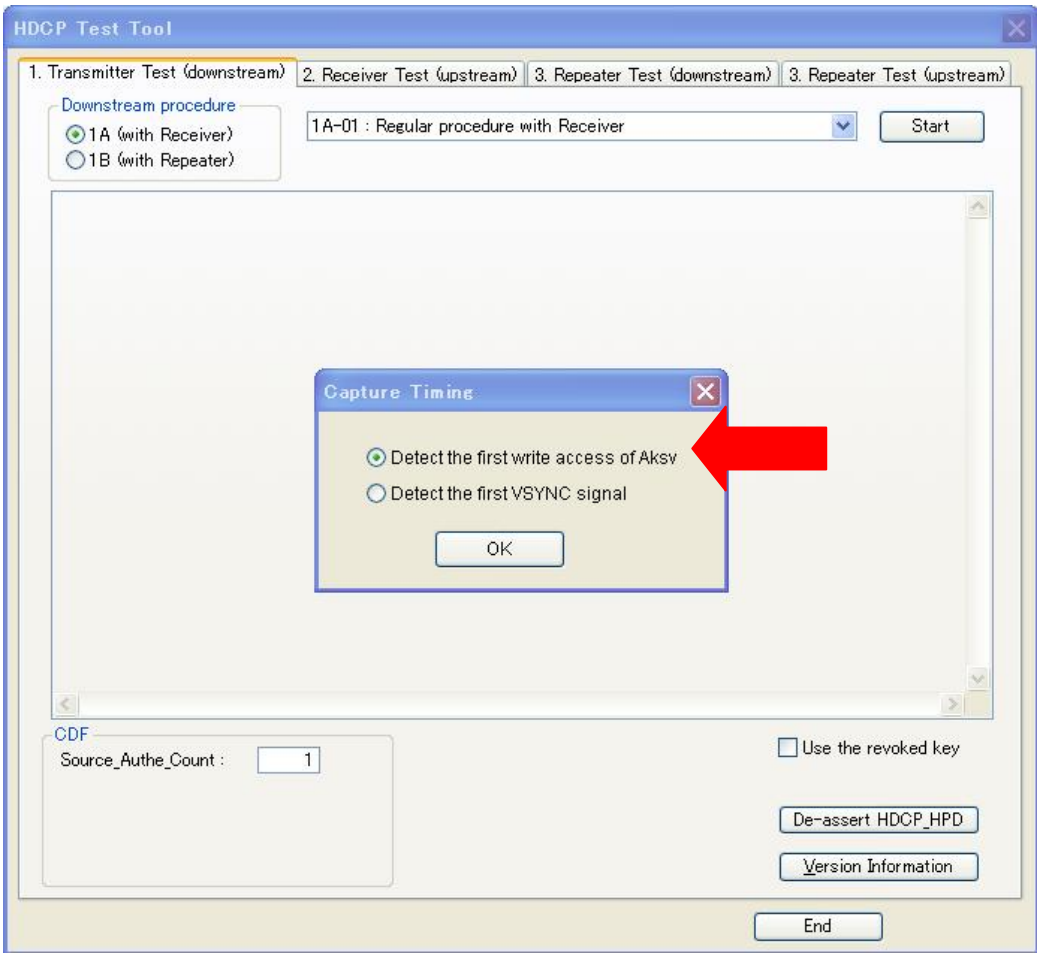
- After “Assert HDCP_HPD” button is clicked, or a test has been done, UITA-2000 (hardware) is in the following status:

(b) HDCP_HPD (physical HPD line) is asserted and HDCP register is disabled

- If you wants to change UITA-2000's status from (b) to (a), please use "De-assert HDCP_HPD" button.



(12) As for “1A-01”, “1A-09” and “1B-01” test, the following dialog is shown. In these tests, TMDS data which Source (DUT) outputs is captured and verified. Select the timing of starting the capture in the shown dialog and push “OK” button to continue.

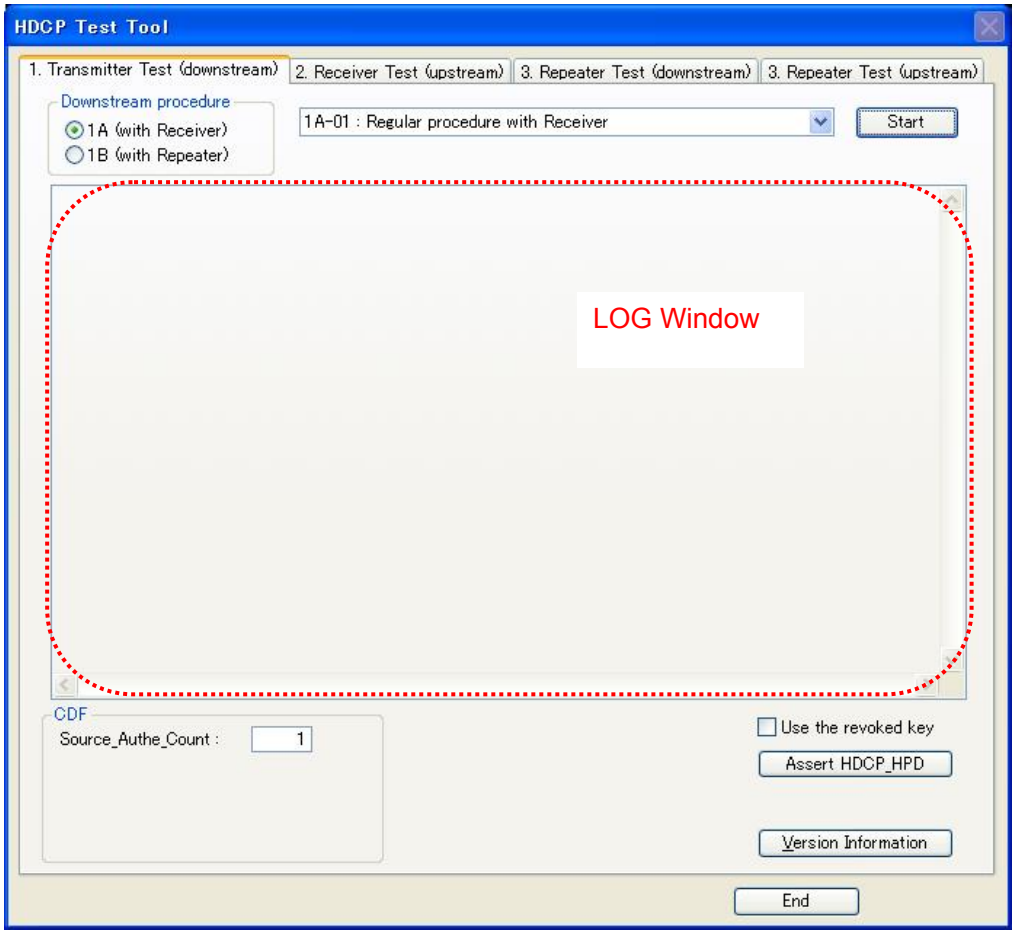


There are two options as the timing of starting the capture.

- "Detect the first write access of Aksv"
  This is default setting and usually RECOMMENDED.
- "Detect the first VSYNC signal"
  This is only usable for DUT such as to enable HDCP encryption too fast after writing Aksv and HDCP encryption is enabled just from or before the first frame of the captured data.

If “Source_Authe_Count” exceeds one, the timing of starting capture is not selectable. It is fixed on “Detect the first write access of Aksv” and the above dialog is not shown.

(13) The verification test starts and the LOG of the performed procedure is outputted in the LOG window. The same LOG is saved as the text file you named.



As for the tests other than “1A-01”, “1A-09” and “1B-01” test, the tool finishes the verification test of the authentication procedure automatically in the pre-defined period.

Verification Test of HDCP encryption

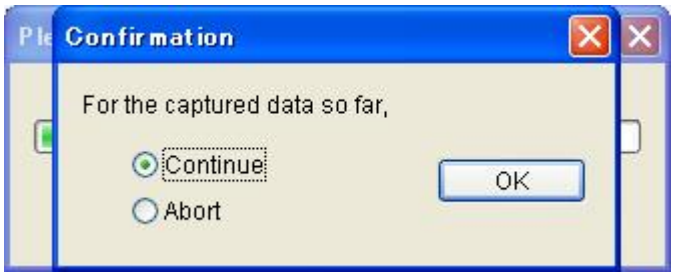
This is performed in the case of “1A-01”, “1A-09” and “1B-01” test.

(14) After the verification test of the authentication procedure, the following dialog is shown and the tool uploads the captured data.

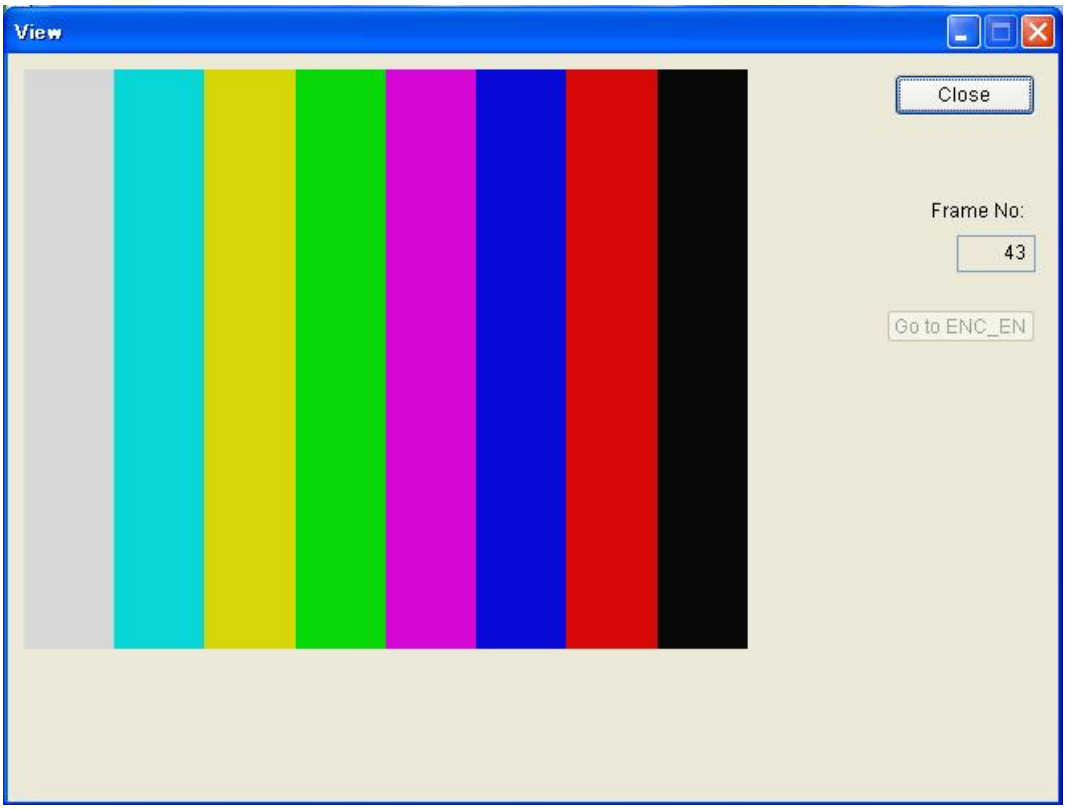
When the tool completes to upload the maximum size of the captured data (1G bytes), then the above dialog disappears automatically. It is recommended to perform a test of full size (1G bytes) of the captured data at least once.

If it is considered as sufficient to observe 10 HDCP encryption enabled frames of correct image, you can cancel the upload on the way. You can cancel the upload at any timing you like. The necessary size of the captured data depends on the timing which DUT enables HDCP encryption and display content. Be sure that the size is enough if you are going to get the result of the verification test.

If you cancel the upload on the way, the confirmation dialog is shown. If you want to start the verification test of HDCP encryption on the uploaded data so far, then select “Continue”. If you want to cancel the verification test of HDCP encryption completely, then select “Abort”.



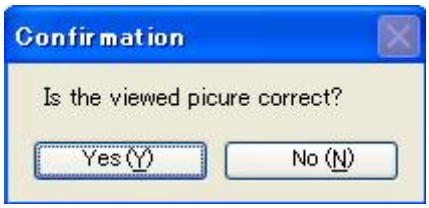
(15) Then the tool starts to verify the TMDS structure regarding HDCP encryption. Confirm the decrypted video shown in the View window on your eyes. The BCH structures of the decrypted packets are checked automatically.



Note: If you push “Close” button, the tool closes the View window but continues to verify the TMDS structure regarding HDCP encryption.

Note: If “Go to ENC_EN” button is enabled, by pushing this, you can skip some ENC_DIS frames. However, especially when the data is captured by the timing "Detect the first VSYNC signal", this functionality is not guaranteed.

At the end of the test, the following Confirmation message dialog is shown. Answer the result of observing the decrypted video in the View window.



Next, the following Confirmation message dialog is shown.

The initial value in the dialog shows the following:

(a) the frame number where ENC_EN signal is first detected

The above value (a) and the following value (b) must be compared:

(b) the frame number when the first frame of upstream content appears in the video window i.e. transition from a “blue screen”, “black screen” or informative on-screen display to movie

Note: There is the exception to this rule when testing Set-Top Boxes and Computers. This exception is applied to the case that output content is not necessary to be protected.

1. If test is not an exception case, input the value and select [OK].
   - The input value is more than one frame prior to the detection of ENC_EN signal, then test result is FAIL.
2. If test is an exception case to this rule, select [Cancel]. In this case, the above two frame numbers, (a) and (b) are not compared.

LOG description

This is a sample LOG of “1A-01” test.

```
High-bandwidth Digital Content Protection System Compliance Test v1.2
Test ID: (1A-01) Regular procedure: With HDMI Receiver
Date: 2009/12/28
HDCPTestTool Version: 2. 0. 0. 00

------
Capture Timing = Detect the write access of Aksv
Source_Authe_Count = 1
Key used = Authorized Key

------
(1A-01) 'Regular procedure: With HDMI Receiver' has started

>>  TE has de-asserted HDCP_HPD
>>  TE has asserted HDCP_HPD
<<  TE has detected TMDS signal
<<  TE has detected VSYNC signal
00000: -                <-   HDCP:   1B from 0x00 (Bksv) is read
00001: -        33ms <-   HDCP:   1B from 0x40 (Bcaps) is read
<<  TE has detected HDMI signal
00002: -       867ms <-   HDCP:   8B from 0x18 (An) is written
00003: -        49ms <-   HDCP:   5B from 0x10 (Aksv) is written
>>  TE has started the capture of TMDS

The first part of authentication has started
<<  TE has not found HDMI signal
00004: -        34ms <-   HDCP:   5B from 0x00 (Bksv) is read
<<  TE has detected HDMI signal
00005: -       165ms <-   HDCP:   2B from 0x08 (R0') is read

HDCP encryption was enabled
The third part of authentication has started
00006: -       234ms <-   HDCP:   2B from 0x08 (Ri') is read
00007: -       117ms <-   HDCP:   2B from 0x08 (Ri') is read
00008: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00009: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00010: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00011: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00012: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00013: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00014: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read

.........

00080: -       115ms <-   HDCP:   2B from 0x08 (Ri') is read
00081: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
00082: -       117ms <-   HDCP:   2B from 0x08 (Ri') is read
00083: -       116ms <-   HDCP:   2B from 0x08 (Ri') is read
```

User Input information

Sequential No. of HDCP access

(*1) This line means “One byte from offset address 0x00 of TE’s HDCP register (i.e. it corresponds to Bksv) is read by DUT”

This line means “One byte from offset address 0x40 of TE’s HDCP register (i.e. it corresponds to Bcaps) is read by DUT after 33 ms from the previous HDCP port access (*1)”

```
00084: -        116ms <-    HDCP:    2B from 0x08 (Ri') is read
00085: -        116ms <-    HDCP:    2B from 0x08 (Ri') is read
00086: -        116ms <-    HDCP:    2B from 0x08 (Ri') is read
<<   TE has completed the capture of TMDS
>>   TE has started the upload of the captured data to PC

The captured data is going to be analyzed
317769 pixel(s) was/were discarded

--------------------- Frame No = 1 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 2 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 3 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

……

--------------------- Frame No = 12 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 13 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 14 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 15 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 16 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

……


--------------------- Frame No = 590 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 591 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded
```

When the capture of TMDS is completed, the verification test of the authentication procedure ends

If TE does not consider that it found out the whole of a frame in the data, TE discards the part of the data and continues to find a frame in the data

HDCP encryption disable signal is found in this frame

HDCP encryption enable signal is found in this frame

```
--------------------- Frame No = 592 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 593 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 594 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 595 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded
99937 pixel(s) was/were discarded

   The picture of content was viewed at Frame No. 15

This test was completed
    ERROR: 0 items
    ERROR in the analyzed data : 0 items
    WARNING in the analyzed data : 0 items
    Viewed Picture: OK
 =======> PASS
```

The number of errors of the verification test of the authentication procedure

The number of errors/warnings of the verification test of HDCP encryption

The operator's input by viewing the decrypted video in the View window

If the DUT accesses to HDCP port too fast too many times (for example, 0ms or 1ms read loop), the output of HDCP access messages may be delayed and then the output order between HDCP access messages with the sequential No. and other messages without the sequential No. may be not synchronized relatively.

ERROR and WARNING is outputted like the following:

ERROR([error code]): [error content]

WARNING([warning code]): [warning content]

ERROR = DUT's operation does not meet expectations and it is prohibited.

WARNING = DUT's operation does not meet expectations but it is not treated as a failure.

If the verification test is completed, the tool outputs "PASS"/"FAIL" in the end of the LOG. If DUT responds to fall outside the programmed criteria, the tool outputs "NOT JUDGED" in the end of the LOG.

Note: If Source_Authe_Count is more than1, UITA outputs errors as for all of authentication, if any. However, only the errors which are done after "Source_Authe_Count"th authentication

are counted and used for the test result.

4. Receiver Test for Sink Device

'HDCPTestTool.exe' and UITA-2000 emulate for the Source function as Test Equipment (TE) and perform Receiver Test for Sink (DUT).

4.1. Test Items

The Receiver Test (upstream) has the following test items:

The tool functions as Source		
2C-01	Regular	Procedure with Transmitter
	Verification test for the procedure which Sink performs the first part and the third part of the authentication with HDMI-capable Source	
2C-02	Regular	New authentication (1st)
	Verification test for the procedure which Sink performs when Source starts the new authentication during the first part of the authentication	
2C-03	Regular	New authentication (3rd)
	Verification test for the procedure which Sink performs when Source starts the new authentication during the third part of authentication	
2C-04	Regular	Procedure with DVI Transmitter
	Verification test for the procedure which Sink performs the first part and the third part of the authentication with DVI Source	

4.2. Test Operation

Preparation (TMDS data creation)

To perform each test, the corresponding 1G bytes TMDS data is necessary. It is transmitted from TE to DUT during the verification test of the authentication procedure. 'TMDSCreate.exe' is used to create the necessary TMDS data for each test.

Total three kinds of data can be created by 'TMDSCreate.exe'.

- TMDS data for "2C-01" and "2C-02"test
- TMDS data for "2C-03" test
- TMDS data for "2C-04" test

(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

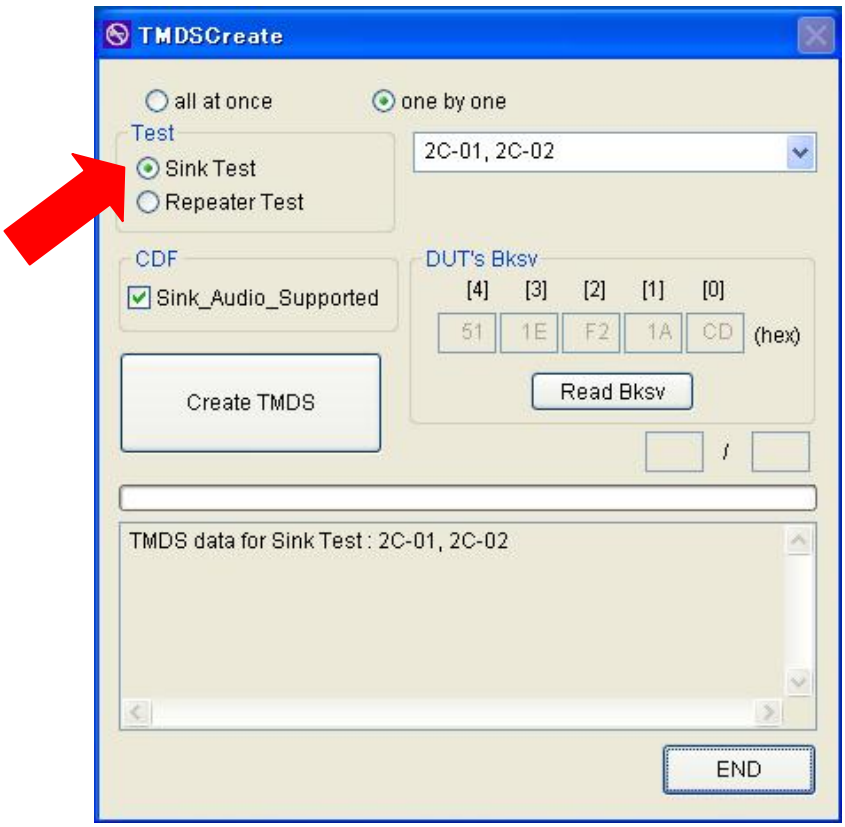
Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

(2) Turn on DUT (Sink).

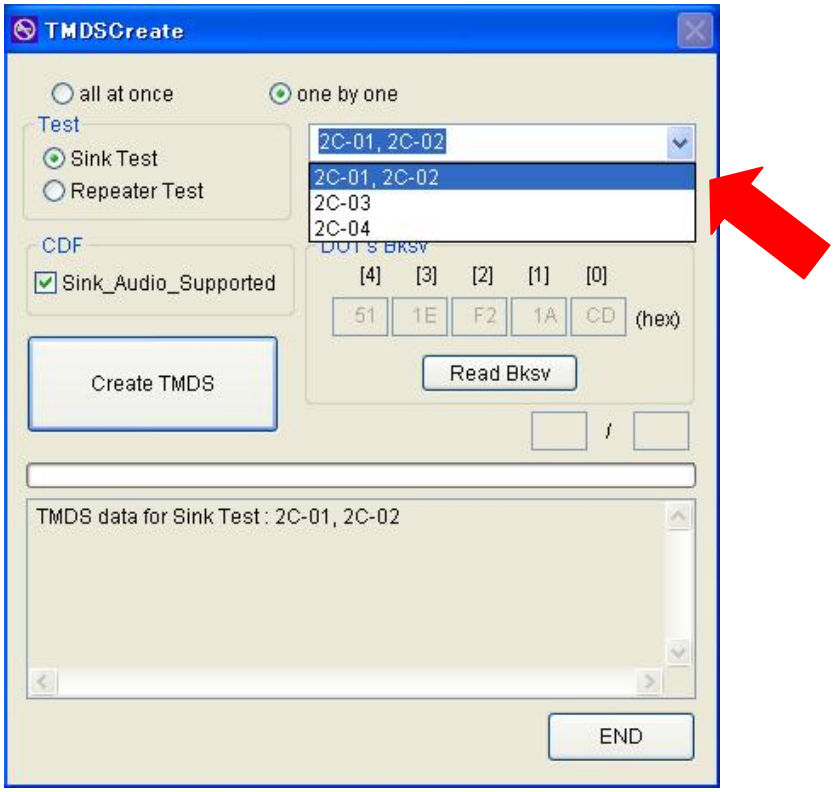
(3) Set DUT's input to HDMI.

(4) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of TE to "HDMI IN" connecter of DUT)

(5) Start ‘TMDSCreate.exe’ by double-clicking it on PC and select “Sink Test”.

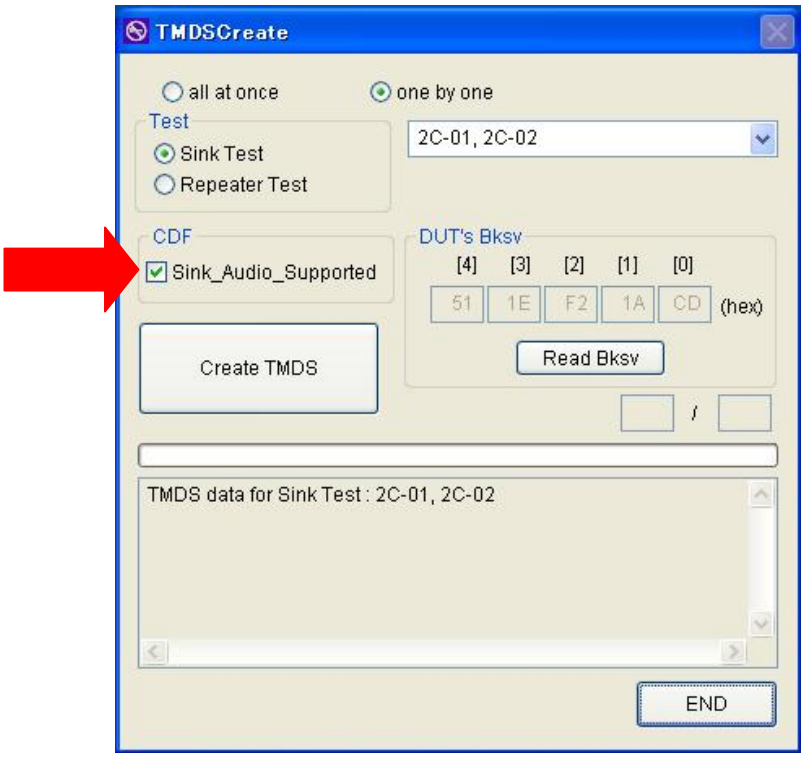


(6) Select the data item to create by selecting the corresponding test-ID.

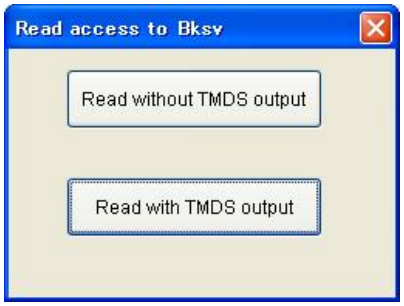


By selecting “all at once” instead of “one by one” (default), you can create all TMDS data for Sink Test that can be provided by ‘TMDSCreate.exe’ at once.

(7) Except for the case of selecting “2C-04” test, if DUT supports audio output, i.e. DUT extracts the audio signal to speakers or output ports, select “Sink_Audio_Supported”. Then audio data is included in TMDS test data.



(8) Push “Read Bksv” button. Then “Read access to Bksv” dialog is shown like the following.



The order of usage of each button is recommended as follows:

(i) Use "Read without TMDS output" button.

If DUT does not need video signal to make its HDCP port readable, then push “Read without TMDS output” button. DUT’s Bksv is read without TMDS output.

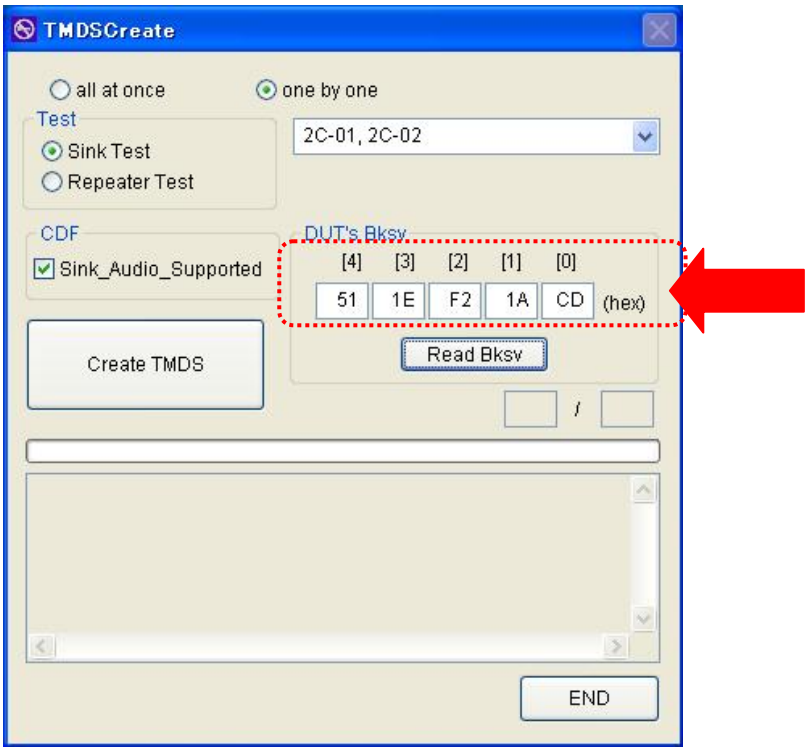
(ii) Use "Read with TMDS output" button (if the above (i) fails).

If DUT needs video signal to make its HDCP port readable, then push “Read with TMDS output” button. In this case, the download of the TMDS data starts first and then, DUT’s Bksv is read (retried, if necessary) with TMDS output.

If the read access succeeds, the five bytes value of DUT’s Bksv is displayed in [0] - [4] box in main dialog.

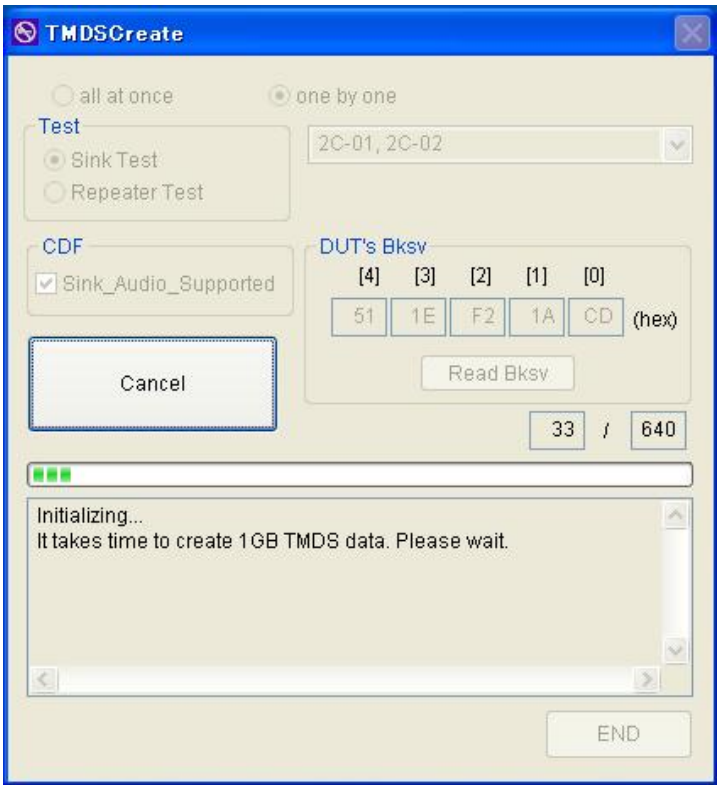
(iii) Enter a Bksv manually.

If the above (i) and (ii) fails, [0] - [4] box for DUT’s Bksv in main dialog can be input manually. Input the five bytes value in the box directly.



(9) Push “Create TMDS” button. Select/create the filename and push “Save” button to continue.

(10) The creation of TMDS data starts. Once the creation starts, you can unplug USB and disconnect DUT and TE.



(11) To cancel the creation of TMDS data on the way, push “Cancel” button.

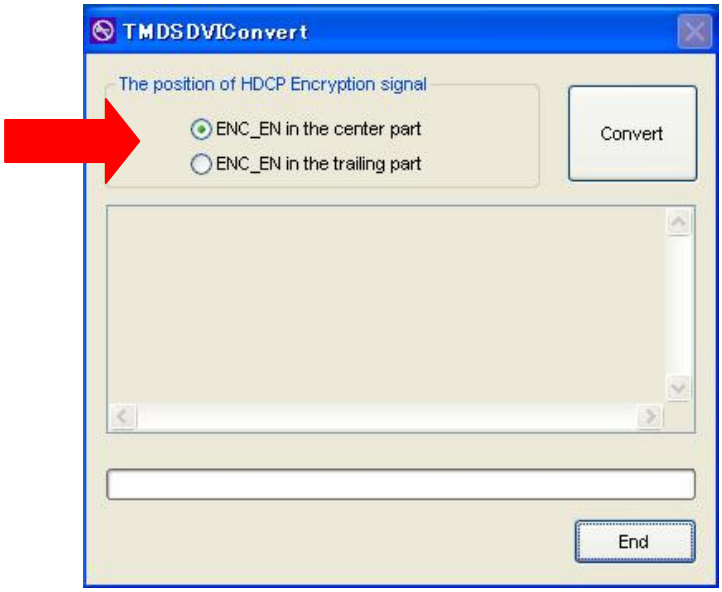
- To create another TMDS data, start again from (1) to (10).

- For “2C-04” test, three kinds of data shall be used according to the position of the HDCP Encryption signal during the period from VSYNC active edge before the first video data in the frame as the following.

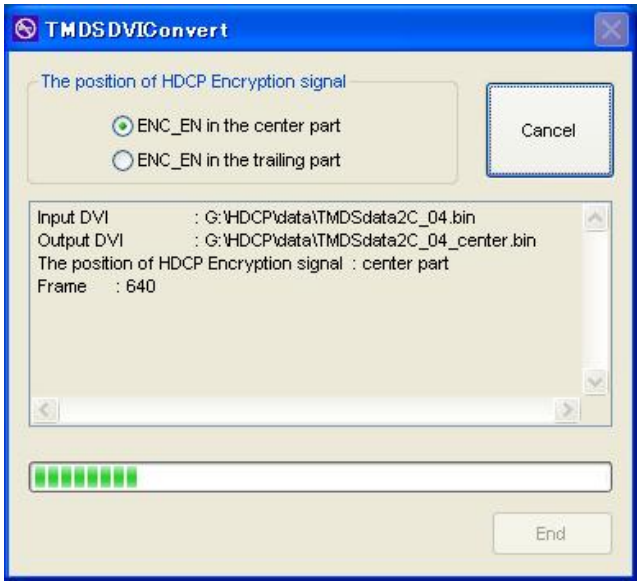
  A) OESS: ENC_EN signal is positioned in the leading part.
  B) OESS: ENC_EN signal is positioned in the center part.
  C) OESS: ENC_EN signal is positioned in the trailing part.

  To create the above A) data, use ‘TMDSCreate.exe’. Then convert A) data to B) or C) data by ‘TMDSDVIConvert.exe’.

(i) Start 'TMDSDVIConvert.exe' by double-clicking it on PC and select one of the options of the tool as for "The position of HDCP Encryption signal"; "ENC_EN in the center part" or "ENC_EN in the trailing part".

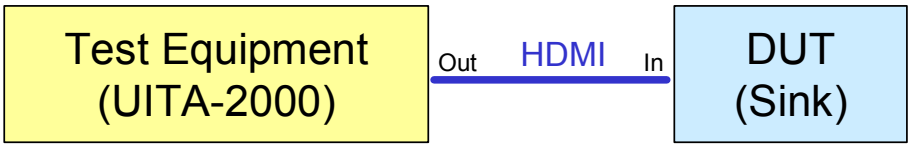


(ii) Click "Convert" button. Select the TMDS DVI data file which was created by 'TMDSCreate.exe'. Create the file/folder to save the converted TMDS DVI data. Then, the conversion starts and the converted data is created.



Connection Setup for Test

- ☐ Connect TE to the upstream HDCP-protected Interface Port of DUT.



(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

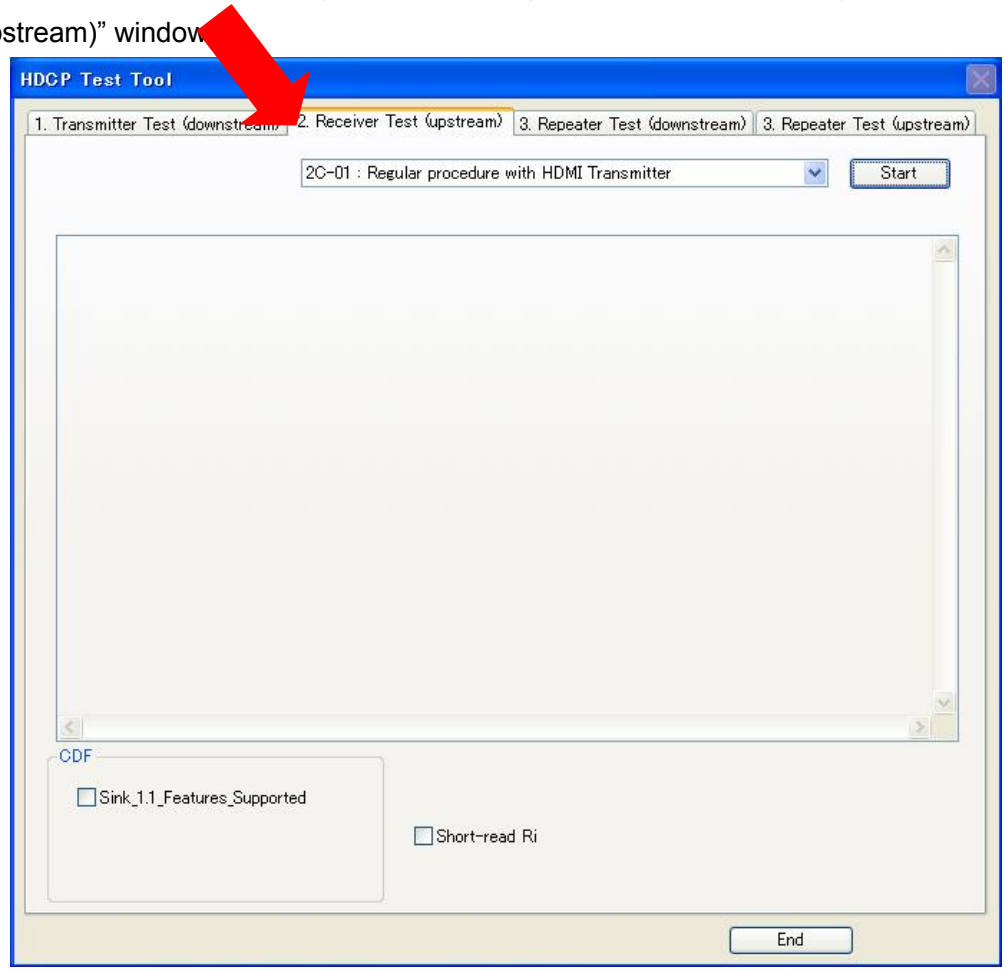
(2) Turn on DUT (Sink).

(3) Set DUT's input to HDMI.

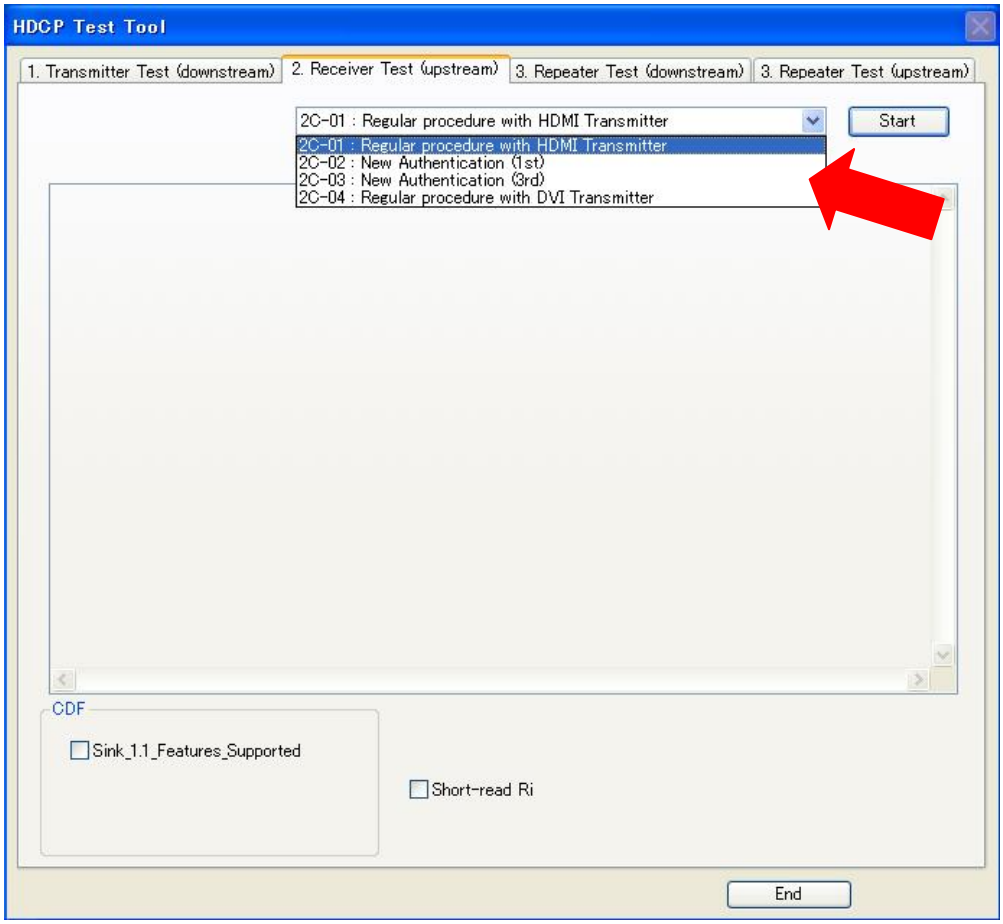
(4) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of TE to "HDMI IN" connecter of DUT)

Verification Test of the authentication procedure

(5) Start 'HDCPTestTool.exe' by double-clicking it on PC and display "2. Receiver Test (upstream)" window

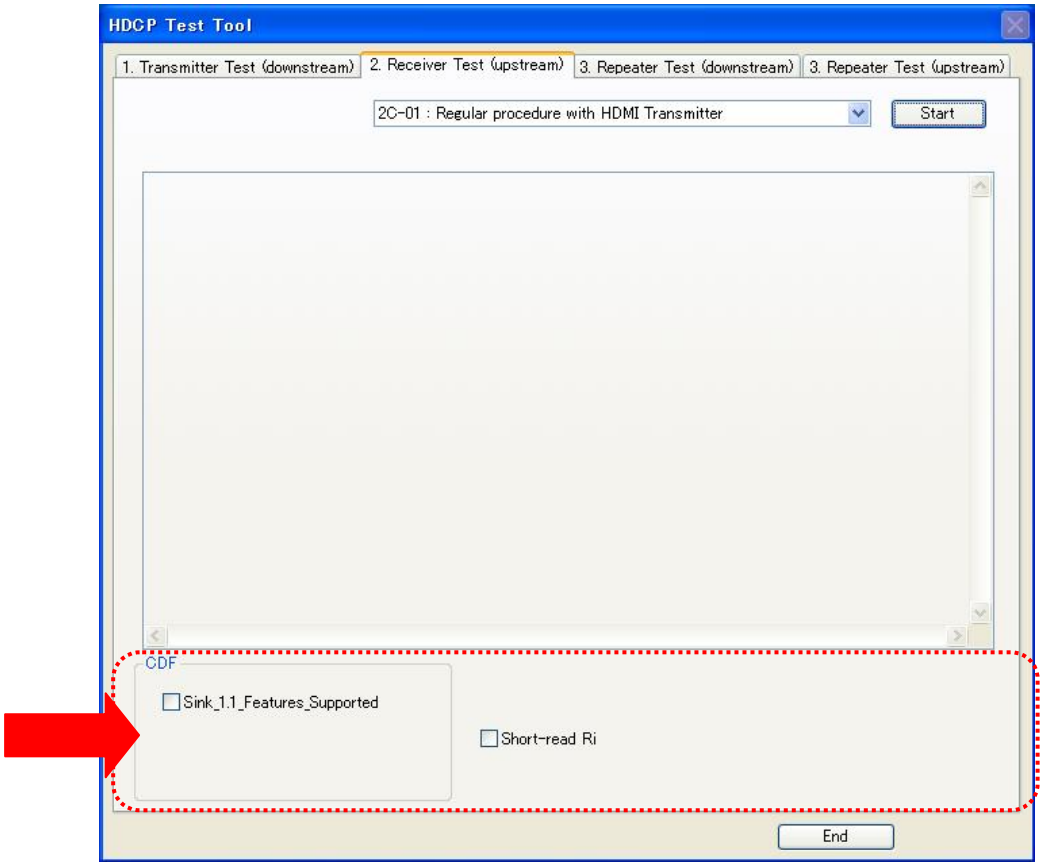


(6) Select the test item by selecting the corresponding test-ID.



(7) Input the necessary setting for the test.

The each test is performed on the basis of the information input by the operator.



Input Parameter list

Product Capability Parameter (PCP)

(a) Sink_1.1Features_Supported = Does DUT support ADVANCED_CIPHER mode and Enhanced Link verification? If Yes, check this.

Others

(b) Write Ainfo = Does TE sets ENABLE_1.1_FEATURES bit of Ainfo to one and perform Enhanced Link Verification? If Yes, check this.

- If Sink_1.1Features_Supported is checked, this can be set.

(c) Short-read Ri = How does TE read Ri in short-format or combined-format? If in short-format, check this.

O = Operator's input is needed

Test ID	(a)	(b)	(c)
2C-01	O	O	O
2C-02	O	-	-
2C-03	O	-	-
2C-04	O	-	O

(8) Click "Start" button. Select/create the filename and folder to save the LOG and push "Save" button to continue.

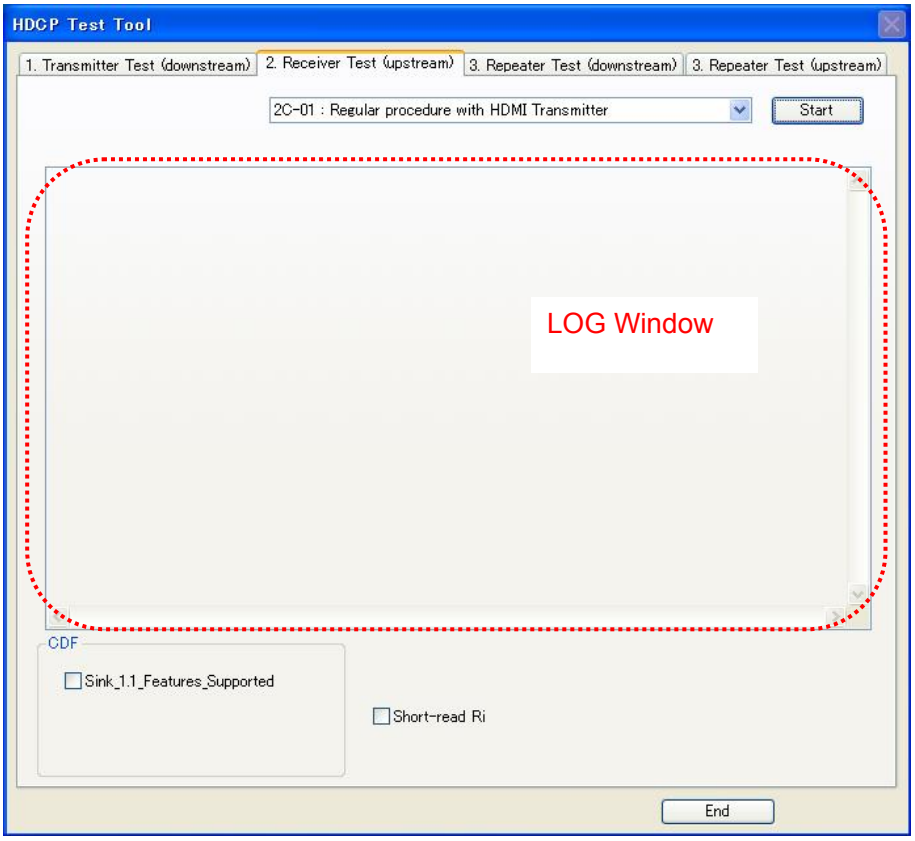
- **Before starting each test, make sure to unplug and plug HDMI connecter. It may be necessary for some DUT.**

(9) If the dialog for selecting the TMDS data to download is shown, select the corresponding data for the test. The download of the TMDS data starts.

- The download of TMDS data is performed only in the following case:
  - The first "Receiver Test" after HDCPTestTool.exe is started.
  - The test using a different TMDS data was previously performed.
- DO NOT TURN OFF UITA-2000 if you want to use the same TMDS data as the one which the previously performed test used.
- Re-start "HDCPTestTool.exe" every time you want to download the TMDS data.

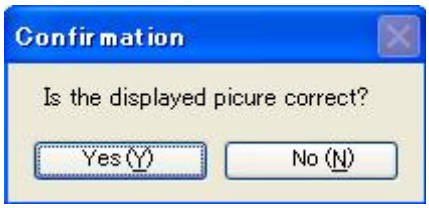
(10) Push “OK” button when the dialog like the following appears.

(11) The verification test starts and the LOG of the performed procedure is outputted in the LOG window. The same LOG is saved as the text file you named.



Confirm the decrypted video (color bar) displayed on DUT on your eyes while testing and listen for tone while observing the video if DUT supports audio output.

At the end of the test, the following Confirmation message dialog is shown. Answer the result of observing the decrypted video on DUT while testing. The result of listening for tone should be included to this answer.



In “2C-01”, “2C-02” and “2C-03” test, even if the answer is “No” due to visual errors such as snow or listening errors such as no sound, this result alone is not considered “FAIL”. If there are errors in the authentication procedure, then the test result is “FAIL”.

LOG description

This is a sample LOG of “2C-01” test.

```
High-bandwidth Digital Content Protection System Compliance Test v1.2
Test ID: (2C-01) Regular procedure: With HDMI Transmitter
Date: 2009/12/28
HDCPTestTool Version: 2. 0. 0. 00

------
Sink_1.1Features_Supported = No
How to read Ri = Combined format access

------
(2C-01) 'Regular procedure: With HDMI Transmitter' has started

Data Filename: TMDSdata2C_01_02.bin

>>  TE has started to download the data to UITA-2000
00000: -                 ->    read HDCP:    2B from 0x41 (Bstatus)
>>  TE has started the output of TMDS
<<  TE has detected TMDS signal
<<  TE has detected HDMI signal
<<  TE has detected VSYNC signal
00001: -        9ms ->    read HDCP:    5B from 0x00 (Bksv)
00002: -        2ms ->    read HDCP:    3B from 0x05 (Rsvd)
00003: -        2ms ->    read HDCP:    5B from 0x0B (Rsvd)
00004: -        2ms ->    read HDCP:    2B from 0x16 (Rsvd)
00005: -        2ms ->    read HDCP:   12B from 0x34 (Rsvd)
00006: -        6ms ->    read HDCP:   32B from 0x44 (Rsvd)
00007: -        5ms ->    read HDCP:   32B from 0x64 (Rsvd)
00008: -        5ms ->    read HDCP:   32B from 0x84 (Rsvd)
00009: -        5ms ->    read HDCP:   28B from 0xA4 (Rsvd)
00010: -        1ms ->    read HDCP:    5B from 0x43 (KSV FIFO)
00011: -      481ms ->    read HDCP:    2B from 0x41 (Bstatus)

00012: -        7ms ->    read HDCP:    1B from 0x40 (Bcaps)
00013: -        4ms ->    read HDCP:    5B from 0x00 (Bksv)
00014: -        4ms ->    write HDCP:   8B from 0x18 (An)
00015: -        4ms ->    write HDCP:   5B from 0x10 (Aksv)

The first part of authentication has started
00016: -      101ms ->    read HDCP:    2B from 0x08 (R0')

HDCP encryption was enabled
The third part of authentication has started
00017: -     2575ms ->    read HDCP:    2B from 0x08 (Ri')
00018: -     2133ms ->    read HDCP:    2B from 0x08 (Ri')
00019: -     2133ms ->    read HDCP:    2B from 0x08 (Ri')
00020: -     2133ms ->    read HDCP:    2B from 0x08 (Ri')
```

User Input information

Sequential No. of HDCP access

(*1) This line means “Two bytes from offset address 0x41 of DUT’s HDCP register (i.e. it corresponds to Bstatus) is read by TE”

TE confirms HDMI_MODE bit of Bstatus == 0

This line means “Five bytes from offset address 0x00 of DUT’s HDCP register (i.e. it corresponds to Bksv) is read by TE after 9 ms from the previous HDCP port access (*1)”

TE confirms HDMI_MODE bit of Bstatus == 1

TE performs the first part of the authentication

TE performs the third part of the authentication

```
<<   TE has completed the output of TMDS
This test was completed
    ERROR: 0 items
    Displayed Picture: OK
 =======> PASS
```

The number of errors of the verification test of the authentication procedure

The operator's input by viewing the displayed video on DUT

ERROR and WARNING is outputted like the following:

ERROR([error code]): [error content]

WARNING([warning code]): [warning content]

ERROR = DUT's operation does not meet expectations and it is prohibited.

WARNING = DUT's operation does not meet expectations but it is not treated as a failure.

If the verification test is completed, the tool outputs "PASS"/"FAIL" in the end of the LOG. If DUT responds to fall outside the programmed criteria, the tool outputs "NOT JUDGED" in the end of the LOG.

Note: If the field value of Bcaps of DUT is different from the expected value of UITA, the expected value of UITA is used for UITA's calculation for R0/Ri/Pj.

For example:

- In "2C-01" test, if DUT sets Bcaps:1.1_FEATURES bit to zero, but "Sink_1.1Features_Supported" is Yes and Input parameter "Write Ainfo" is checked, UITA performs Pj check (Enhanced Link Verification) to this DUT.

5. Downstream Procedure Test for Repeater Device

'HDCPTestTool.exe' and UITA-2000 emulate for the Sink/Repeater function as Test Equipment (TE) and perform the downstream procedure test for Repeater (DUT).

5.1. Test Items

The Repeater Test (downstream) has the following test items:

The tool functions as Sink		
3A-01	Regular	Procedure with HDMI-capable Receiver
	Verification test for the downstream procedure which Repeater performs the first part and the third part of the authentication with HDMI-capable Sink	
3A-02	Irregular	HDCP port access
	Verification test for the downstream procedure which Repeater performs with HDMI-capable Sink when Sink does not respond to HDCP port access	
3A-03	Irregular	Verify Bksv
	Verification test for the downstream procedure which Repeater performs with HDMI-capable Sink when Sink has the invalid Bksv value (all 0)	
3A-04	Irregular	Verify R0'
	Verification test for the downstream procedure which Repeater performs with HDMI-capable Sink when Sink sets the invalid R0' value in the first part of the authentication	
3A-05	Regular	Procedure with DVI Receiver
	Verification test for the downstream procedure which Repeater performs the first part and the third part of the authentication with DVI Sink	
The tool functions as Repeater		
3B-01	Regular	Procedure with Repeater
	Verification test for the downstream procedure which Repeater (DUT) performs the first part, the second part and the third part of the authentication with Repeater	
3B-02	Irregular	Timeout of KSV list READY
	Verification test for the downstream procedure which Repeater (DUT) performs with Repeater when Repeater does not set READY bit of Bcaps in the second part of authentication	
3B-03	Irregular	Verify V'
	Verification test for the downstream procedure which Repeater (DUT) performs with Repeater when Repeater sets the invalid V' value in the second part of the authentication	
3B-04	Irregular	MAX_DEVS_EXCEEDED

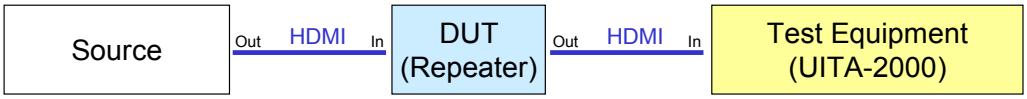
	Verification test for the downstream procedure which Repeater (DUT) performs with Repeater when Repeater sets MAX_DEVS_EXCEEDED bit of Bstatus in the second part of authentication	
3B-05	Irregular	MAX_CASCADE_EXCEEDED
	Verification test for the downstream procedure which Repeater (DUT) performs with Repeater when Repeater sets MAX_CASCADE_EXCEEDED bit of Bstatus in the second part of authentication	

5.2. Test Operation

Connection Setup for Test

For all tests, a Source device that has already passed the Transmitter Test is necessary.

- ☐ Connect a Source device to the upstream HDCP-protected Interface Port of DUT.
- ☐ Connect TE to the downstream HDCP-protected Interface Port of DUT.



(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

(2) Turn on Source and DUT (Repeater).

(3) Set Source's output to HDMI.

(4) Configure Source to output one of the following video format timing.

- 640x480p@59.94/60Hz, RGB
- 720x480p@59.94/60Hz, RGB (RECOMMENDED)
- 720x576p@50Hz, RGB
- ■ Some DUT might need the display device to show the menu for setting the picture resolution. In that case, use another Sink device (display) in order to set DUT's HDMI output video format timing before testing.

(5) Makr Source to start outputting the protected content.

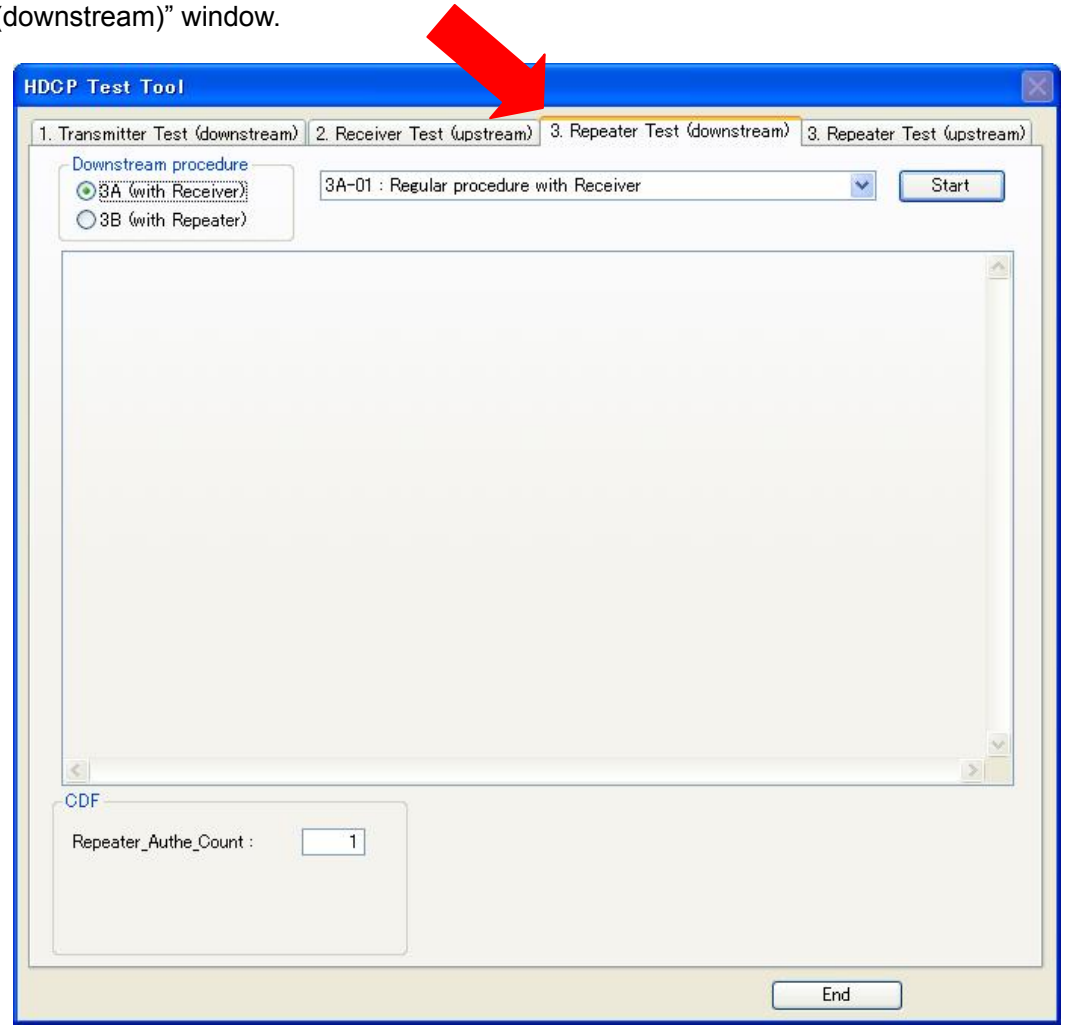
(6) Set DUT's input to HDMI.

(7) Connect Source to DUT using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of Source to "HDMI IN" connecter of DUT)

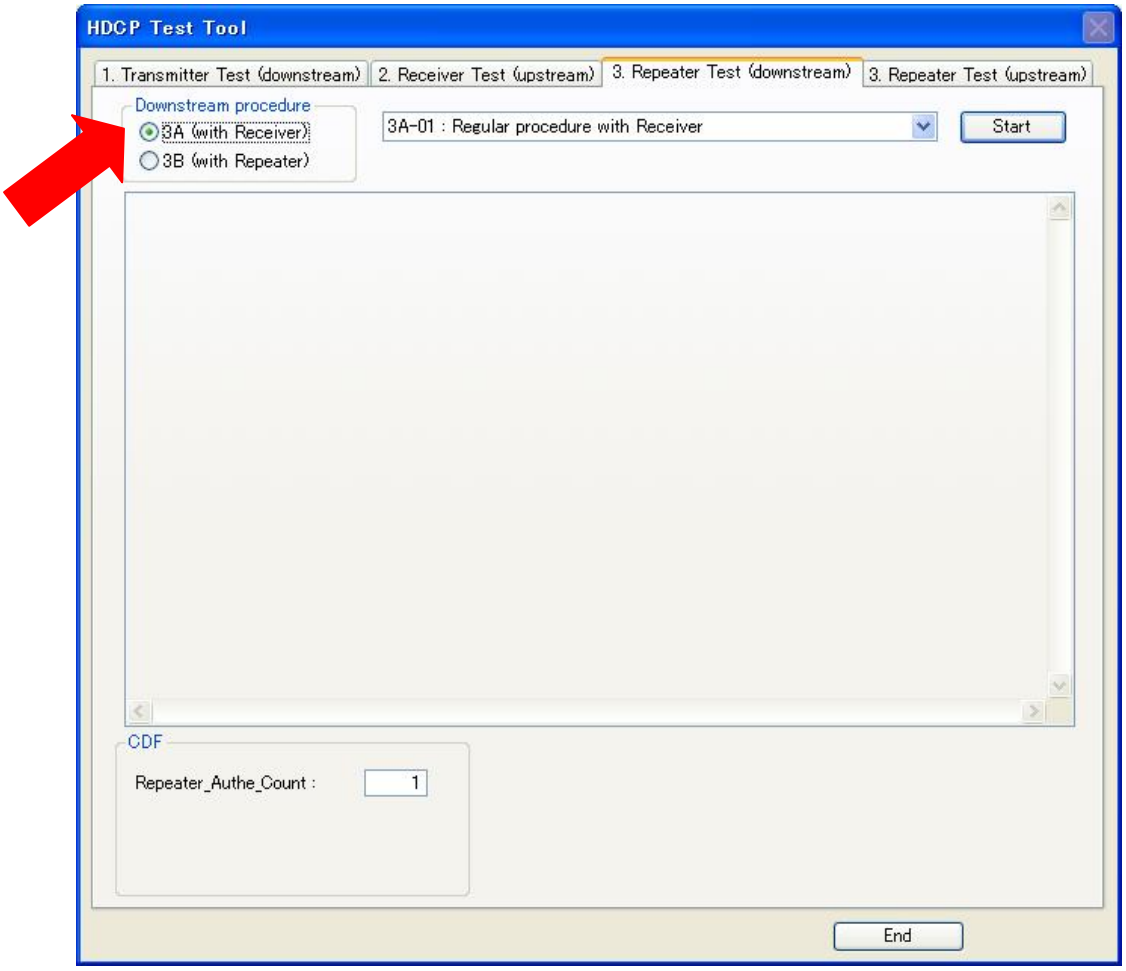
(8) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of DUT to "HDMI IN" connecter of TE)

Verification Test of the authentication procedure

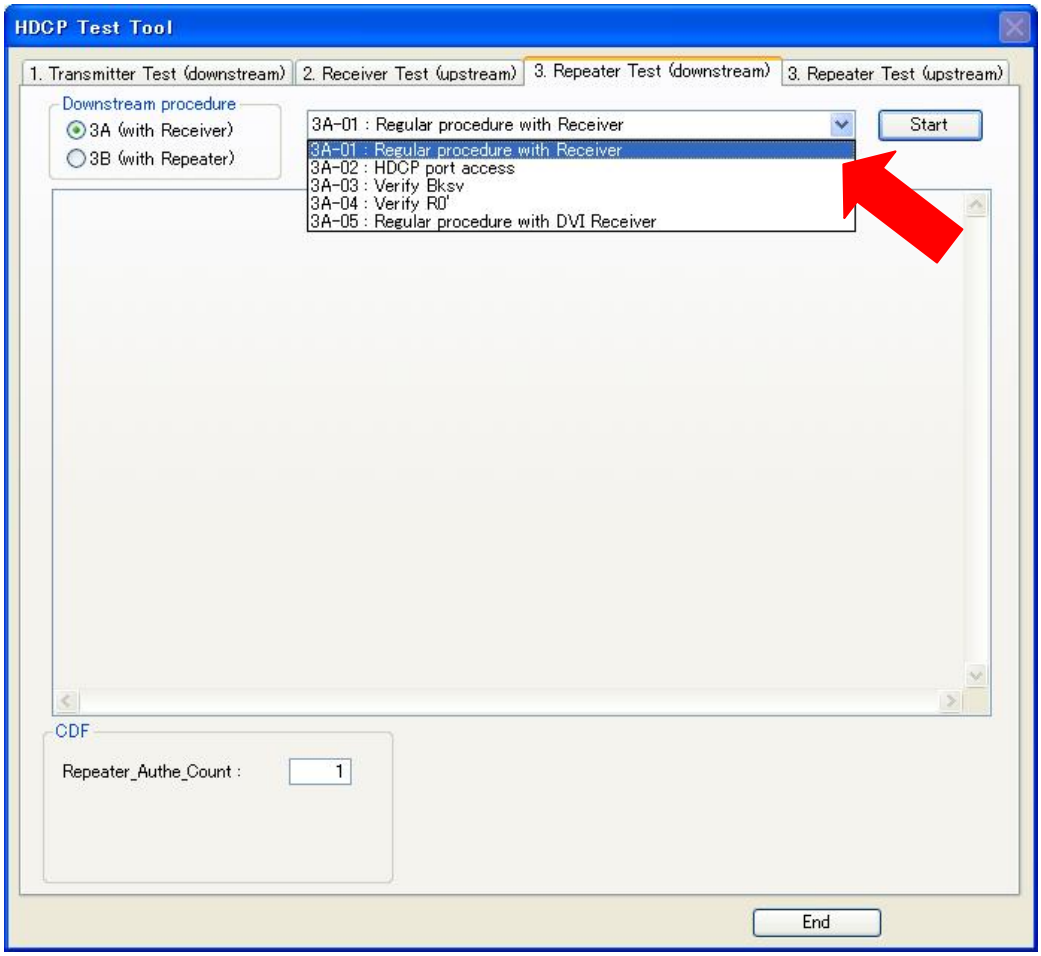
(9) Start 'HDCPTestTool.exe' by double-clicking it on PC and display "3. Repeater Test (downstream)" window.



(10) Select one of the functions of the tool as for “Downstream procedure”, “3A (with Receiver)” or “3B (with Repeater)”.

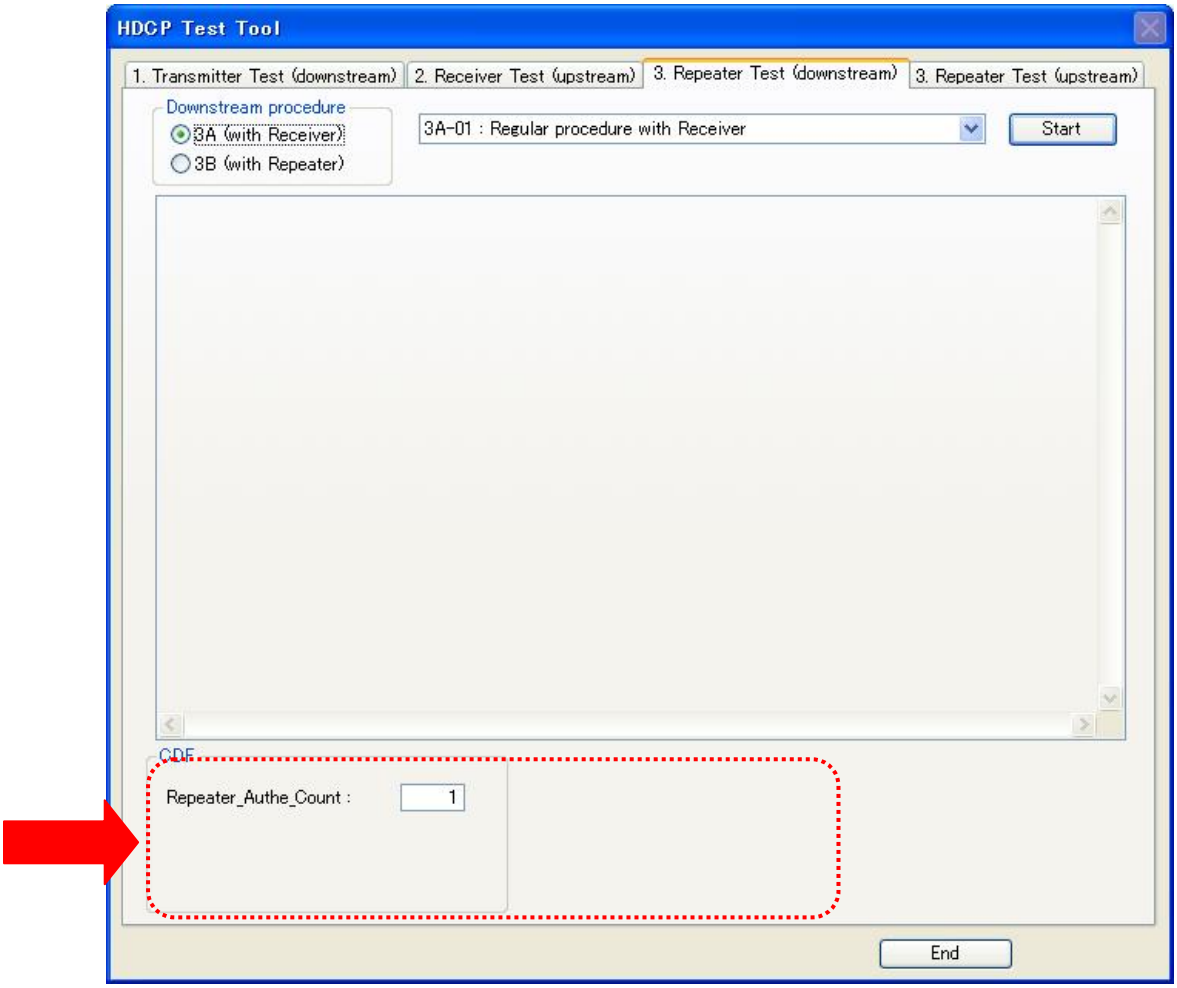


(11) Select the test item by selecting the corresponding test-ID.



(12) Input the necessary setting for the test.

The each test is performed on the basis of the information input by the operator.



Input Parameter list

Product Capability Parameter (PCP)

(a) "Repeater_Authe_Count" = How many times does DUT perform the authentication in order to go into and stay in the authenticated state? The "Repeater_Authe_Count" number of authentication is verified. Input the number from 1 to 10.

(b) "Repeater_Max_KSV" = How many devices are supported by the size of the KSV FIFO of DUT. i.e. The size of KSV FIFO in bytes divided by 5 in the repeater from which the source will read. Not the size of KSV FIFO which the repeater can read. Input the number from 2 to 127.

Others

(c) "DEVICE_COUNT = 0" = TE performs as its DEVICE_COUNT is zero.

(d) "DEVICE_COUNT != 0" = TE performs as its DEVICE_COUNT is not zero.

O = Operator's input is needed

Test ID	(a)	(b)	(c)	(d)
3A -01	O	-	-	-
3A -02	-	-	-	-
3A -03	O	-	-	-
3A -04	O	-	-	-
3A -05	O	-	-	-
3B -01	O	O	O	O
3B -02	O	O	-	-
3B -03	O	O	O	O
3B -04	O	O	-	-
3B -05	O	O	-	-

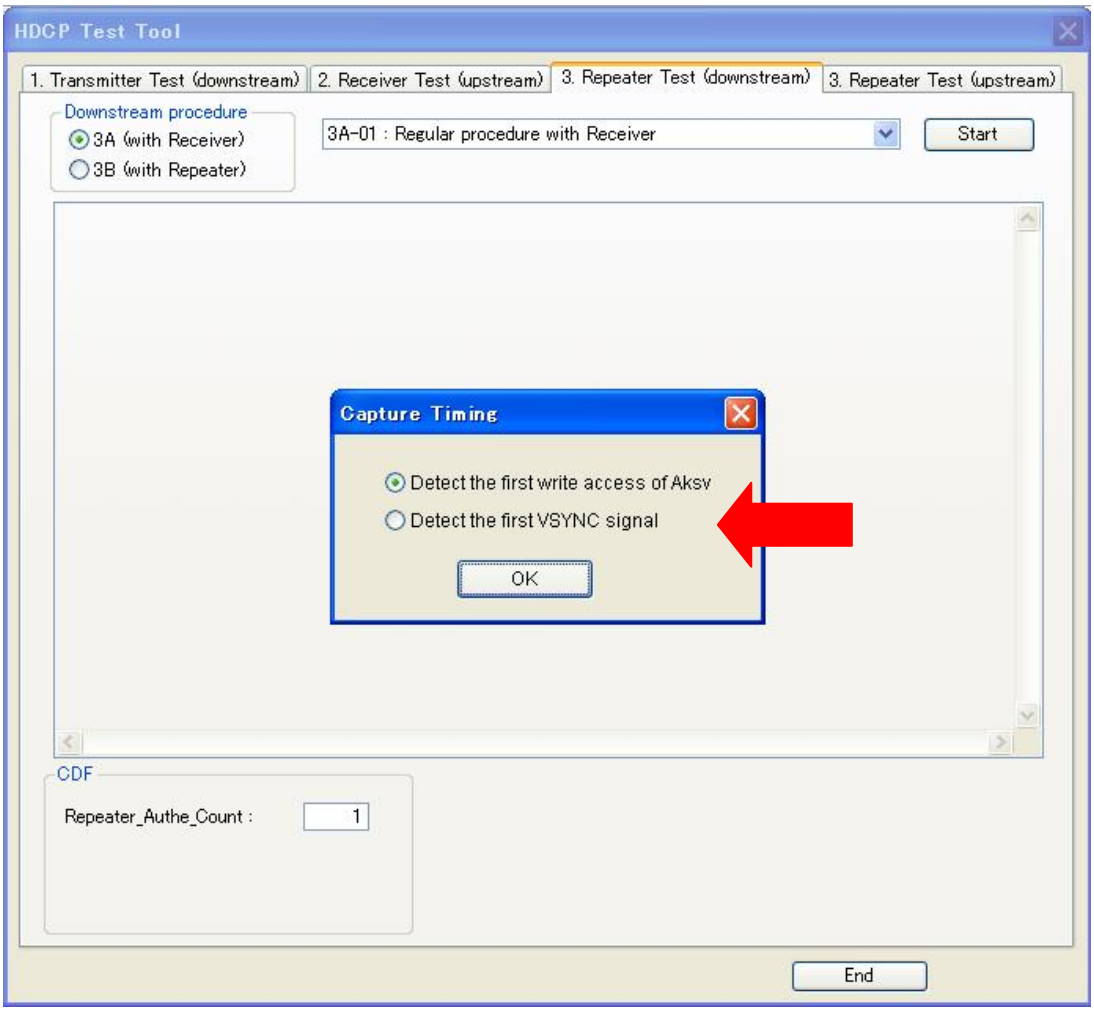
On the basis of value of (a) "Repeater_Max_KSV", TE as Pseudo-Repeater configures its setting of Bstatus:DEPTH and DEVICE_COUNT as the following:

Test ID	DEPTH	DEVICE_COUNT
3B -01	5 or fewer	126 or fewer
3B -02	1	1
3B -03	5 or fewer	5 or fewer
3B -04	1	1
3B -05	1	1

(13) Click “Start” button. Select/create the filename and folder to save the LOG and push “Save” button to continue.

- **Before starting the test, make sure to unplug and plug HDMI connecter especially if you switch the test item between 3A-05 and the others. It may be necessary for some DUT.**

(14) As for “3A-01”, “3A-05” and “3B-01” test, the following dialog is shown. In these tests, TMDS data which Source (DUT) outputs is captured and verified. Select the timing of starting the capture in the shown dialog and push “OK” button to continue.

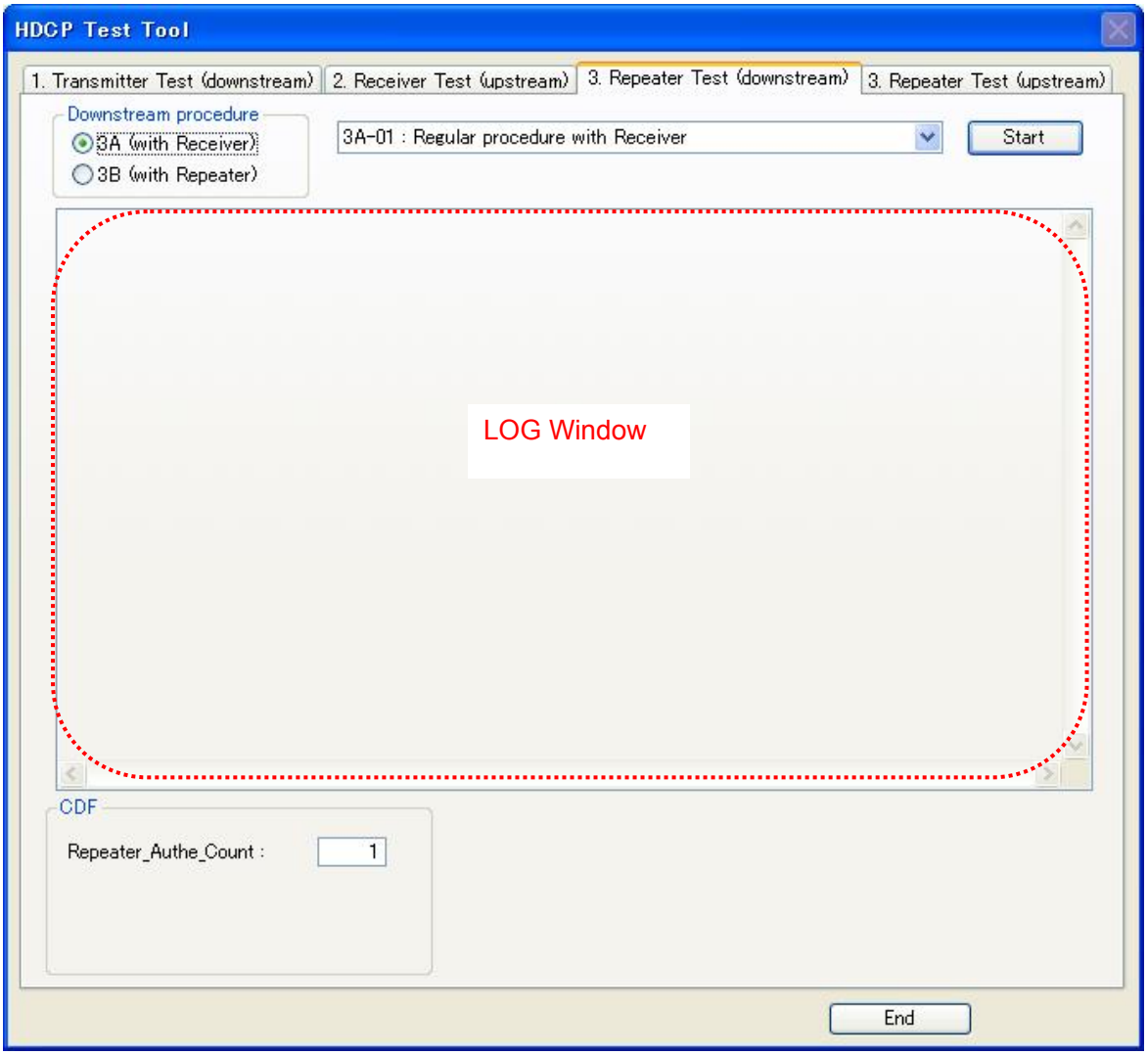


There are two options as the timing of starting the capture.

- "Detect the first write access of Aksv"
  This is default setting and usually RECOMMENDED.
- "Detect the first VSYNC signal"
  This is only usable for DUT such as to enable HDCP encryption too fast after writing Aksv and HDCP encryption is enabled just from or before the first frame of the captured data.

If “Repeater_Authe_Count” exceeds one, the timing of starting capture is not selectable. It is fixed on “Detect the first write access of Aksv” and the above dialog is not shown.

(15) The verification test starts and the LOG of the performed procedure is outputted in the LOG window. The same LOG is saved as the file you named.



As for the tests other than “3A-01”, “3A-05” and “3B-01” test, the tool finishes the verification test of the authentication procedure automatically in the pre-defined period.

Verification Test of HDCP encryption

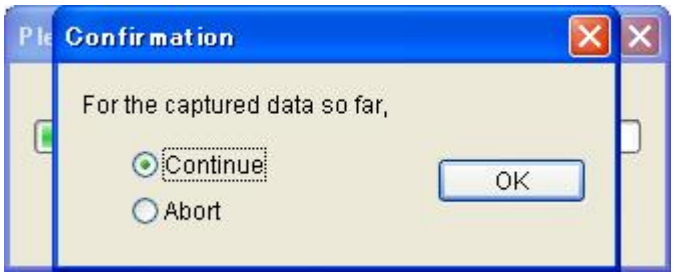
This is performed in the case of “3A-01”, “3A-05” and “3B-01” test.

(16) After the verification test of the authentication procedure, the following dialog is shown and the tool uploads the captured data.

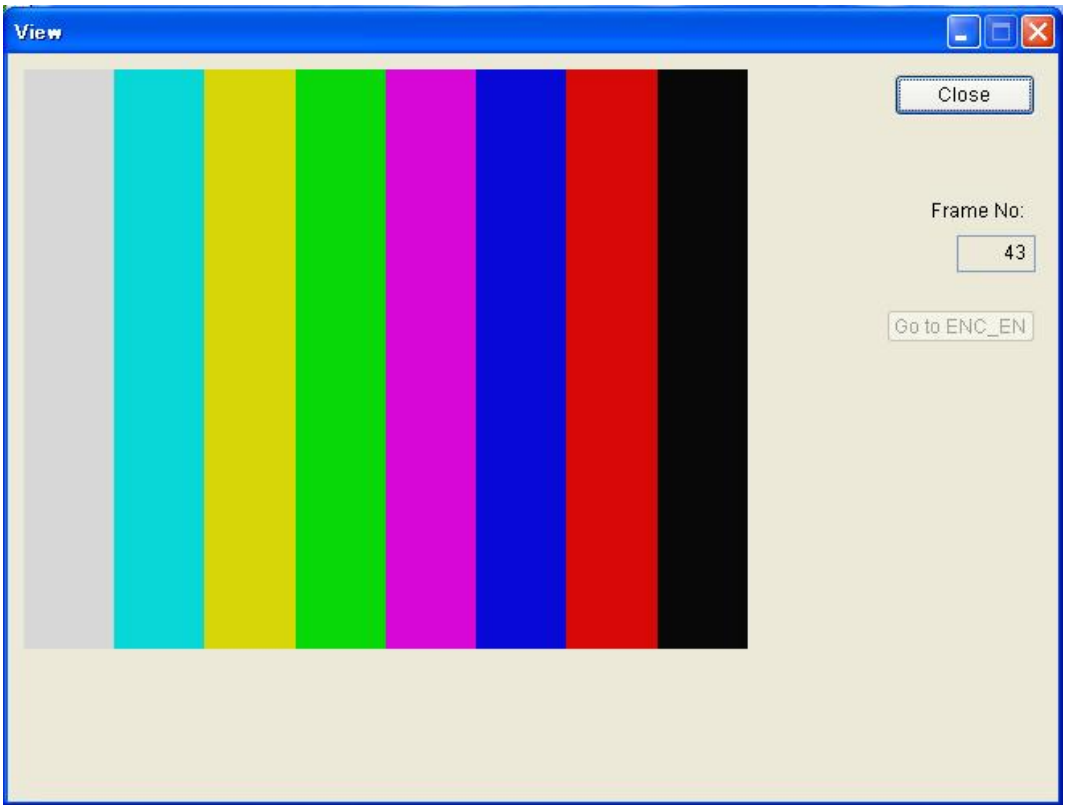
When the tool completes to upload the maximum size of the captured data (1G bytes), then the above dialog disappears automatically. It is recommended to perform a test of full size (1G bytes) of the captured data at least once.

If it is considered as sufficient to observe 10 HDCP encryption enabled frames of correct image, you can cancel the upload on the way. You can cancel the upload at any timing you like. The necessary size of the captured data depends on the timing which DUT enables HDCP encryption and display content. Be sure that the size is enough if you are going to get the result of the verification test.

If you cancel the upload on the way, the confirmation dialog is shown. If you want to start the verification test of HDCP encryption on the uploaded data so far, then select “Continue”. If you want to cancel the verification test of HDCP encryption completely, then select “Abort”.



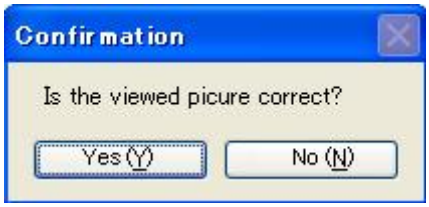
(17) Then the tool starts to verify the TMDS structure regarding HDCP encryption. Confirm the decrypted video shown in the View window on your eyes. The decrypted packets are checked about BCH structure automatically.



Note: If you push “Close” button, the tool closes the View window but continues to analyze the TMDS structure regarding HDCP encryption.

Note: If “Go to ENC_EN” button is enabled, you can skip some ENC_DIS frames by pushing this. However, especially when the data is captured by the timing "Detect the first VSYNC signal", this functionality is not guaranteed.

At the end of the test, the following Confirmation message dialog is shown. Answer the result of observing the decrypted video in the View window.



Next, the following Confirmation message dialog is shown.

The initial value in the dialog shows the following:

(a) the frame number where ENC_EN signal is first detected

The above value (a) and the following value (b) must be compared:

(b) the frame number when the first frame of upstream content appears in the video window i.e. transition from a “blue screen”, “black screen” or informative on-screen display to movie

Input the value and select [OK].

- The input value is more than one frame prior to the detection of ENC_EN signal, then test result is FAIL.

LOG description

This is a sample LOG of “3A-01” test.

```
High-bandwidth Digital Content Protection System Compliance Test
Test ID: (3A-01) Regular procedure: With HDMI Receiver
Date: 2009/12/28
HDCPTestTool Version: 2. 0. 0. 00

------
Capture Timing = Detect the write access of Aksv
Repeater_Authe_Count = 1

------
(3A-01) 'Regular procedure: With HDMI Receiver' has started

>>  TE has de-asserted HDCP_HPD
>>  TE has asserted HDCP_HPD
<<  TE has detected TMDS signal
<<  TE has detected VSYNC signal
<<  TE has not found TMDS signal
<<  TE has detected TMDS signal
<<  TE has detected VSYNC signal
<<  TE has detected HDMI signal
00000: -              <-   HDCP:   5B from 0x00 (Bksv) is read
00001: -        1ms <-   HDCP:   5B from 0x00 (Bksv) is read
00002: -        1ms <-   HDCP:   1B from 0x40 (Bcaps) is read
00003: -        3ms <-   HDCP:   8B from 0x18 (An) is written
00004: -        2ms <-   HDCP:   5B from 0x10 (Aksv) is written
>>  TE has started the capture of TMDS

The first part of authentication has started
00005: -        1ms <-   HDCP:   5B from 0x00 (Bksv) is read
<<  TE has not found HDMI signal
<<  TE has detected HDMI signal
00006: -      103ms <-   HDCP:   2B from 0x08 (R0') is read
00007: -        7ms <-   HDCP:   2B from 0x08 (R0') is read
00008: -      326ms <-   HDCP:   2B from 0x08 (R0') is read

HDCP encryption was enabled
The third part of authentication has started
00009: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
00010: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
00011: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
00012: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
00013: -      331ms <-   HDCP:   2B from 0x08 (Ri') is read
00014: -      149ms <-   HDCP:   2B from 0x08 (Ri') is read

.........

00028: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
00029: -      480ms <-   HDCP:   2B from 0x08 (Ri') is read
```

User Input information

Sequential No. of HDCP access

(*1) This line means “Five bytes from offset address 0x00 of TE’s HDCP register (i.e. it corresponds to Bksv) is read by DUT”

This line means “Five byte from offset address 0x00 of TE’s HDCP register (i.e. it corresponds to Bksv) is read by DUT after 1 ms from the previous HDCP port access (*1)”

```
00030: -          7ms <-    HDCP:    2B from 0x08 (Ri') is read
00031: -        473ms <-    HDCP:    2B from 0x08 (Ri') is read
<<   TE has completed the capture of TMDS
>>   TE has started the upload of the captured data to PC

The captured data is going to be analyzed
182001 pixel(s) was/were discarded

--------------------- Frame No = 1 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 2 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 3 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

.........

--------------------- Frame No = 27 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 28 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 29 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 30 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 31 ----------------------
Encryption disable signal (EESS:ENC_DIS) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 32 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 33 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

--------------------- Frame No = 34 ----------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded
```

When the capture of TMDS is completed, the verification test of the authentication procedure ends

If TE does not consider that it found out the whole of a frame in the data, TE discards the part of the data and continues to find a frame in the data

HDCP encryption disable signal is found in this frame

HDCP encryption enable signal is found in this frame

```
.........

-------------------- Frame No = 592 ---------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

-------------------- Frame No = 593 ---------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

-------------------- Frame No = 594 ---------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded

-------------------- Frame No = 595 ---------------------
Encryption enable signal (EESS:ENC_EN) was detected
450450 pixel(s) was/were discarded
235705 pixel(s) was/were discarded

   The picture of content was viewed at Frame No. 32

This test was completed
    ERROR: 0 items
    ERROR in the analyzed data : 0 items
    WARNING in the analyzed data : 0 items
    Viewed Picture: OK
 =======> PASS
```

The number of errors of the verification test of the authentication procedure

The number of errors/warnings of the verification test of HDCP encryption

The operator's input by viewing the decrypted video in the View window

If the DUT accesses to HDCP port too fast too many times (for example, 0ms or 1ms read loop), the output of HDCP access messages may be delayed and then the output order between HDCP access messages with the sequential No. and other messages without the sequential No. may be not synchronized relatively.

ERROR and WARNING is outputted like the following:

ERROR([error code]): [error content]

WARNING([warning code]): [warning content]

ERROR = DUT's operation does not meet expectations and it is prohibited.

WARNING = DUT's operation does not meet expectations but it is not treated as a failure.

If the verification test is completed with DUT, the tool outputs "PASS"/"FAIL" in the end of the LOG. If DUT responds to fall outside the programmed criteria, the tool outputs "NOT JUDGED" in the end of the LOG.

Note: If Repeater_Authe_Count is more than1, UITA outputs errors as for all of authentication, if any. However, only the errors which are done after “Repeater_Authe_Count”th authentication are counted and used for the test result.

6. Upstream Procedure Test for Repeater Device

'HDCPTestTool.exe' and UITA-2000 emulate for the Source function as Test Equipment (TE) and perform the upstream procedure test for Repeater (DUT).
In some tests, same 'HDCPTestTool.exe' and UITA-2000 emulate for Sink/Repeater function as a pseudo device at the same time and perform the downstream procedure with Repeater (DUT).

6.1. Test Items

The Repeater Test (upstream) has the following test items:

The tool functions as Source		
3C-I-01	Regular	Procedure with Transmitter (downstream with Receiver)
	Verification test for the upstream procedure which Repeater performs the first part, the second part and the third part of the authentication with HDMI-capable Source when Repeater is connected with HDMI-capable Sink on downstream	
3C-I-02	Regular	HDCP_HPD pulse caused by the user operation
	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Repeater is operated manually to de-asserts and asserts HDCP_HPD during the third part of the authentication	
3C-I-03	Irregular	New authentication (1st)
	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Source start the new authentication during the first part of the authentication	
3C-I-04	Irregular	New authentication (2nd)
	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Source starts the new authentication during the second part of the authentication	
3C-I-05	Irregular	New authentication (3rd)
	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Source starts the new authentication during the third part of authentication	
The tool functions as Source and Pseudo-Sink		
3C-I-06	Irregular	Verify Bksv
	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Sink has the invalid Bksv value (all 0)	
3C I-07	Irregular	Verify R0'

	Verification test for the upstream procedure which Repeater performs with HDMI-capable Source when Sink sets the invalid R0' value in the first part of the authentication	
The tool functions as Source		
3C-II-01	Regular	Procedure with Transmitter (downstream with Repeater)
	Verification test for the upstream procedure which Repeater (DUT) performs the first part, the second part and the third part of the authentication with HDMI-capable Source when Repeater (DUT) is connected with Repeater on downstream	
The tool functions as Source and Pseudo-Repeater		
3C-II-02	Regular	HDCP_HPD after writing Aksv
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater de-asserts and asserts HDCP_HPD after receiving the write-access of Aksv	
3C-II-03	Regular	HDCP_HPD after reading R0'
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater de-assets and asserts HDCP_HPD after receiving the read-access of R0'	
3C-II-04	Regular	HDCP_HPD after starting 3rd authe
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater de-asserts and asserts HDCP_HPD during the third part of authentication	
3C-II-05	Irregular	Verify V'
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater sets the invalid V' value in the second part of the authentication	
3C-II-06	Irregular	DEVICE_COUNT
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater sets DEVICE_COUNT of Bstatus to the maximum number which Repeater (DUT) supports in the second part of authentication	
3C-II-07	Irregular	DEPTH
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater sets DEPTH of Bstatus to 7 in the second part of authentication	
3C-II-08	Irregular	MAX_DEVS_EXCEEDED
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater sets MAX_DEVS_EXCEEDED bit of Bstatus in the second part of authentication	
3C-II-09	Irregular	MAX_CASCADE_EXCEEDED
	Verification test for the upstream procedure which Repeater (DUT) performs with HDMI-capable Source when Repeater sets MAX_CASCADE_EXCEEDED bit of Bstatus in the second part of authentication	

6.2. Test Operation

Preparation (TMDS data creation)

To perform each test, the corresponding 1G bytes TMDS data is necessary. It is transmitted from TE to DUT during the verification test of the authentication procedure. 'TMDSCreate.exe' is used to create the necessary TMDS data for each test.

Total three kinds of data are necessary.

- TMDS data for "3C-I-04" test
- TMDS data for "3C-I-05" test
- TMDS data for other tests

(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

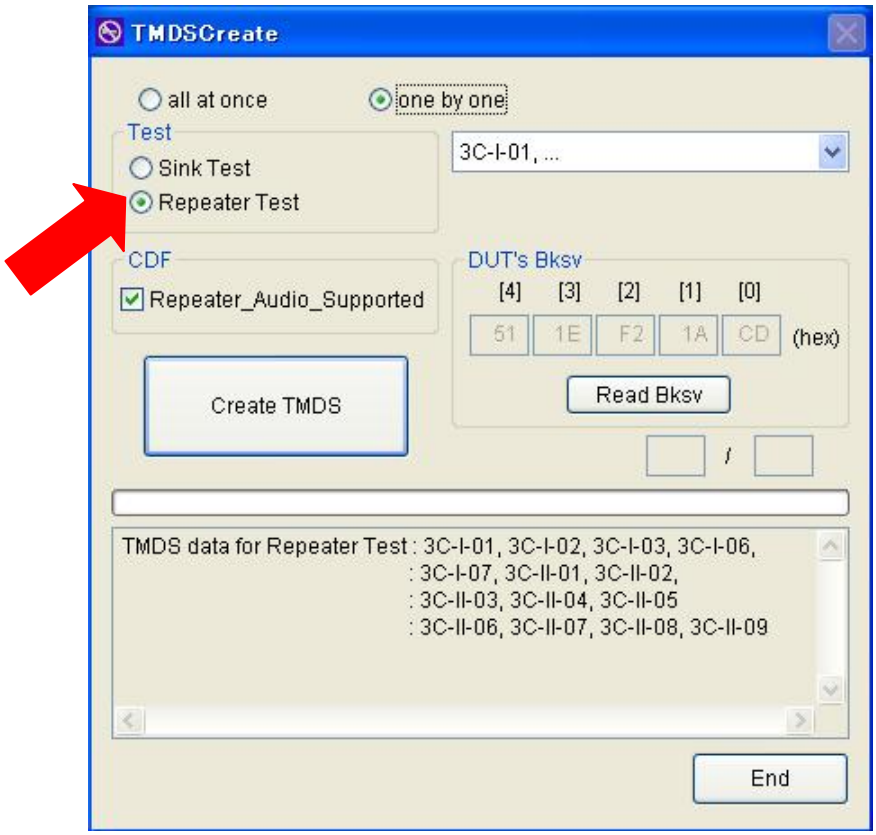
Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

(2) Turn on DUT (Repeater).

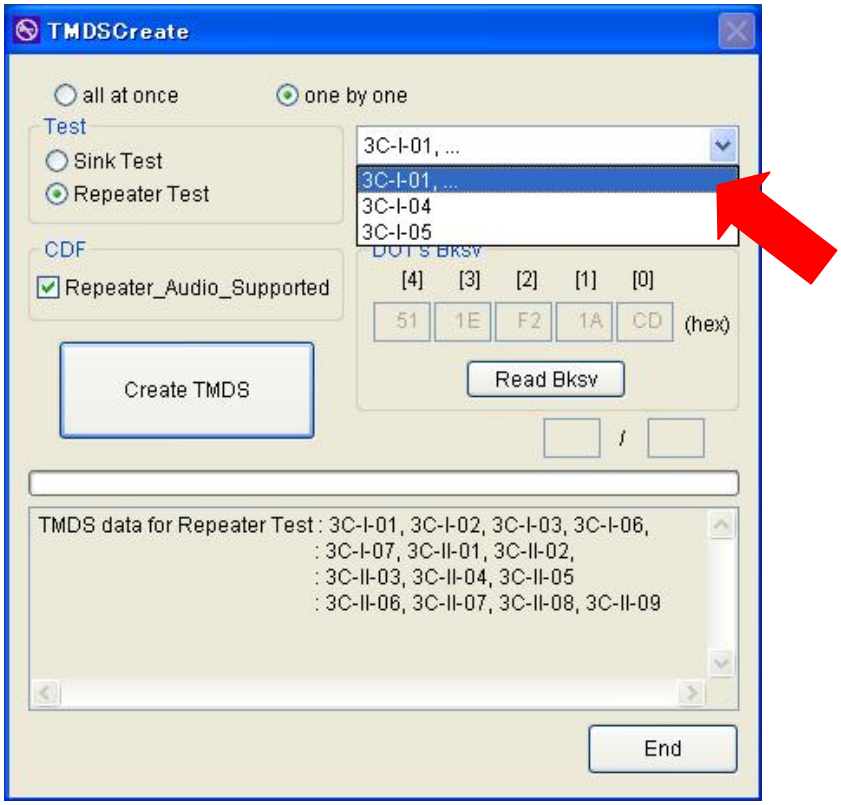
(3) Set DUT's input to HDMI.

(4) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of TE to "HDMI IN" connecter of DUT)

(5) Start 'TMDSCreate.exe' by double-clicking it on PC and select "Repeater Test".

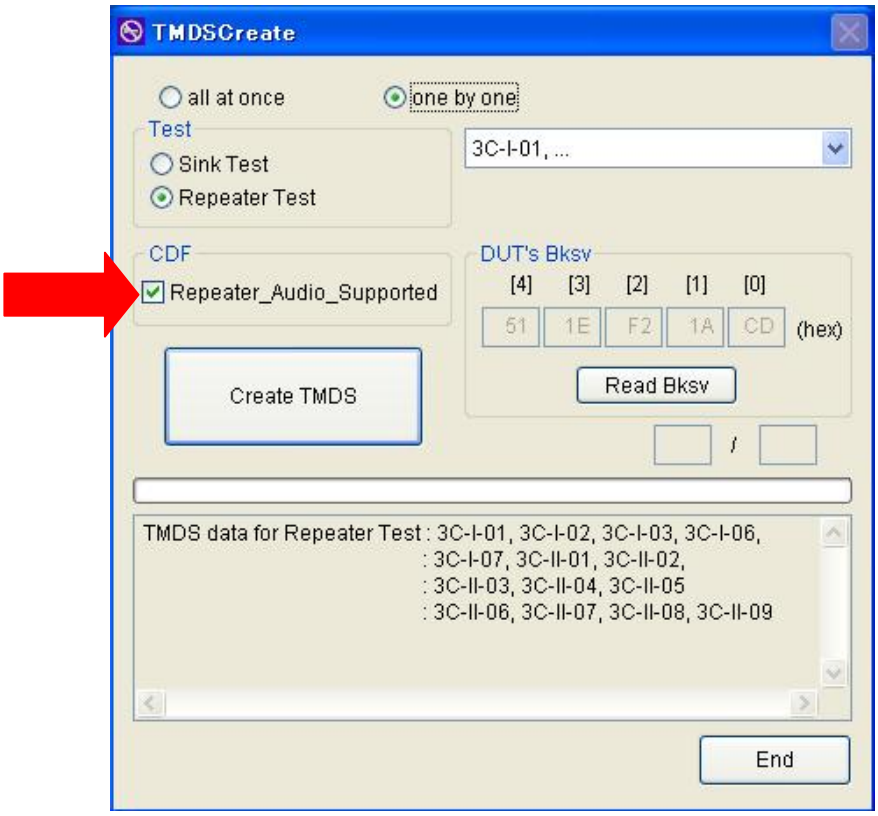


(6) Select the data item to create by selecting the corresponding test-ID.

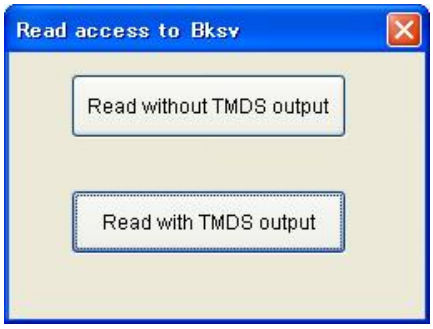


By selecting “all at once” instead of “one by one” (default), you can create all TMDS data for Repeater Test that can be provided by ‘TMDSCreate.exe’ at once.

(7) If DUT supports audio output, i.e. DUT extracts the audio signal to speakers or output ports, select “Repeater_Audio_Supported”. Then the audio is included in TMDS test data



(8) Push “Read Bksv” button. Then “Read access to Bksv” dialog is shown like the following.



The order of usage of each button is recommended as follows:

(i) Use "Read without TMDS output" button.

If DUT does not need video signal to make its HDCP port readable, then push “Read without TMDS output” button. DUT’s Bksv is read without TMDS output.

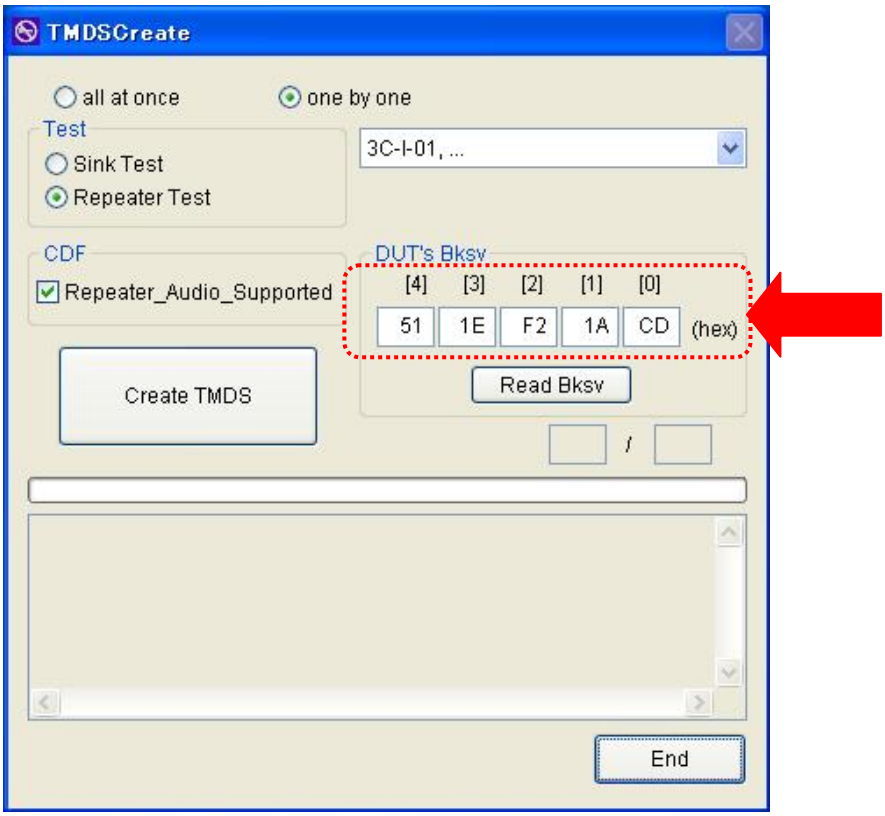
(ii) Use "Read with TMDS output" button (if the above (i) fails).

If DUT needs video signal to make its HDCP port readable, then push “Read with TMDS output” button. First, the download of the TMDS data starts and DUT’s Bksv is read (retried, if necessary) with TMDS output.

If the read access succeeds, the five bytes value of DUT’s Bksv is displayed in [0] - [4] box in main dialog.

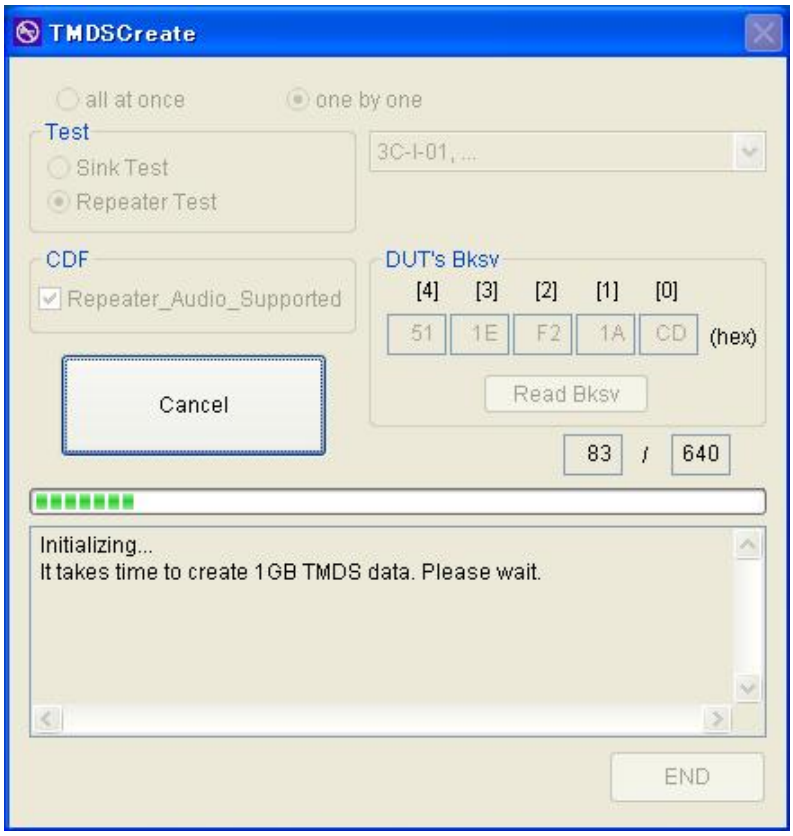
(iii) Enter a Bksv manually.

If the above (i) and (ii) fails, [0] - [4] box for DUT’s Bksv in main dialog can be input manually. Input the five bytes value in the box directly



(9) Push “Create TMDS” button. Select/create the filename and push “Save” button to continue.

(10) The creation of TMDS data starts. Once the creation starts, you can unplug USB and disconnect DUT and TE.



(11) To cancel the creation of TMDS data on the way, push “Cancel” button.

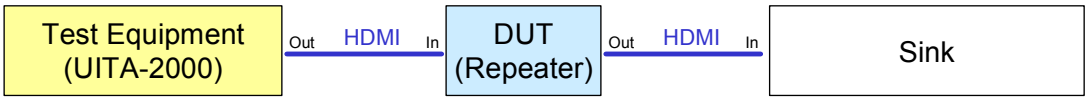
- To create another TMDS data, start again from (1) to (10).

Connection Setup for Test

<For 3C-I-01, 3C-I-02, 3C-I-03, 3C-I-04 and 3C-I-05>

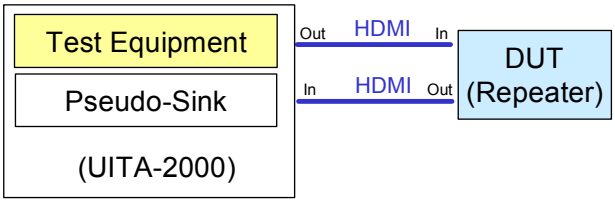
A Sink device that has already passed the Receiver Test is necessary.

- ☐ Connect TE to the upstream HDCP-protected Interface Port of DUT.
- ☐ Connect a Sink device to the downstream HDCP-protected Interface Port of DUT.



<For 3C-I-06 and 3C-I-07>

- ☐ Connect TE to the upstream HDCP-protected Interface Port of DUT.
- ☐ Connect Peudo-Sink to the downstream HDCP-protected Interface Port of DUT.

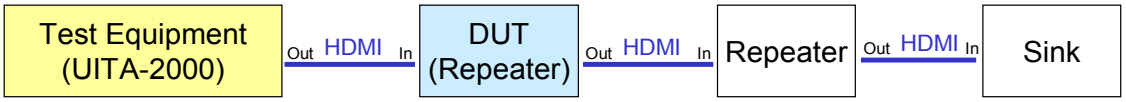


<For 3C-II-01>

A Sink device that has already passed the Receiver Test is necessary.

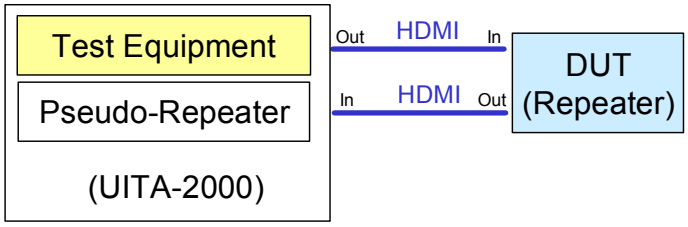
A Repeater device that has already passed the Repeater Test is necessary.

- ☐ Connect TE to the upstream HDCP-protected Interface Port of DUT.
- ☐ Connect a Repeater device which is connected with a Sink device to the downstream HDCP-protected Interface Port of DUT.



<For 3C-II-02, 3C-II-03, 3C-II-04, 3C-II-05, 3C-II-06, 3C-II-07, 3C-II-08 and 3C-II-09>

- ☐ Connect TE to the upstream HDCP-protected Interface Port of DUT.
- ☐ Connect Pseudo-Repeater to the downstream HDCP-protected Interface Port of DUT.



(1) Turn on TE (UITA-2000) and connect it to PC by USB.

!! NOTICE !!

Please make sure to connect UITA-2000 to the PC by USB cable **AFTER UITA-2000 IS TURNED ON**.

(2) Turn on DUT (Repeater).

(3) Turn on Sink/Repeater if necessary.

(4) Set DUT's input to HDMI.

(5) Set DUT's output to HDMI.

(6) Set Sink's input to HDMI if necessary.

(7) Set Repeater's input to HDMI if necessary.

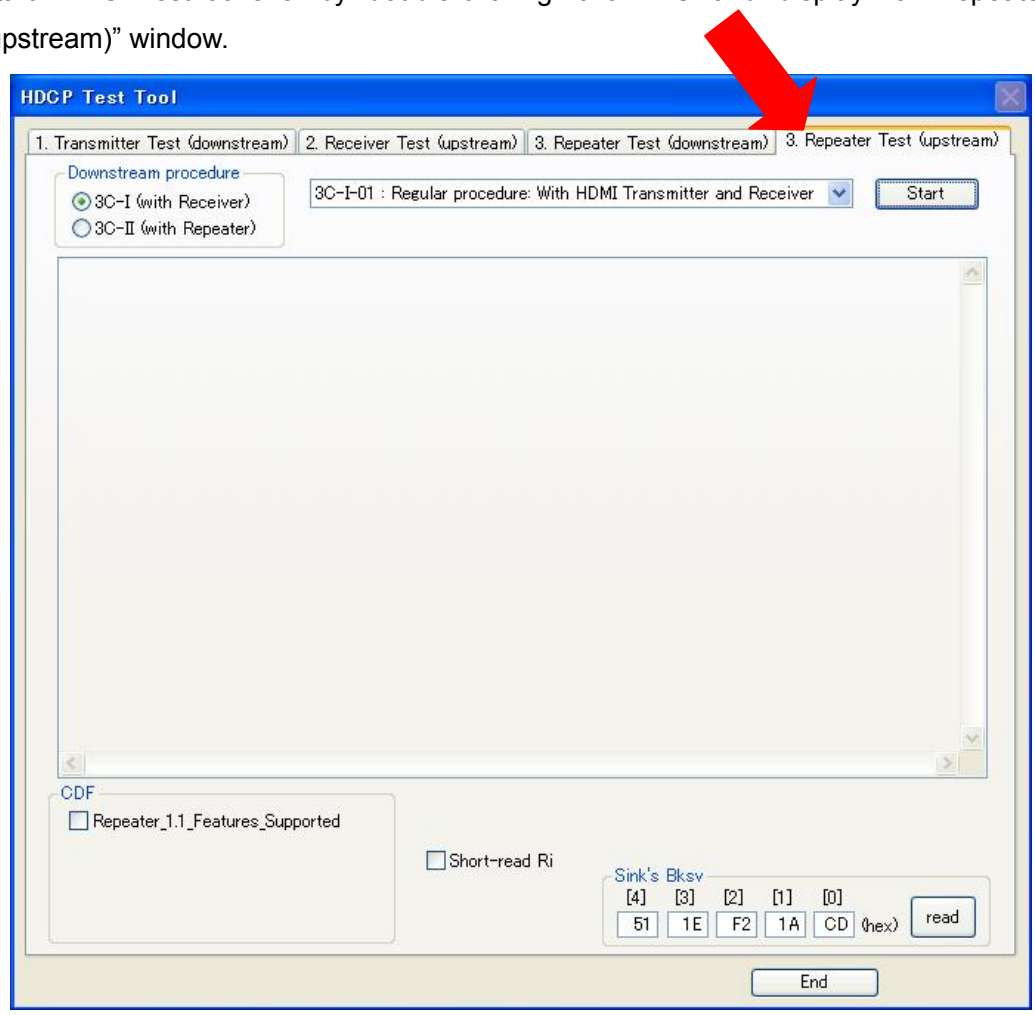
(8) Set Repeater's output to HDMI if necessary.

(9) Connect DUT to TE using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of TE to "HDMI IN" connecter of DUT)

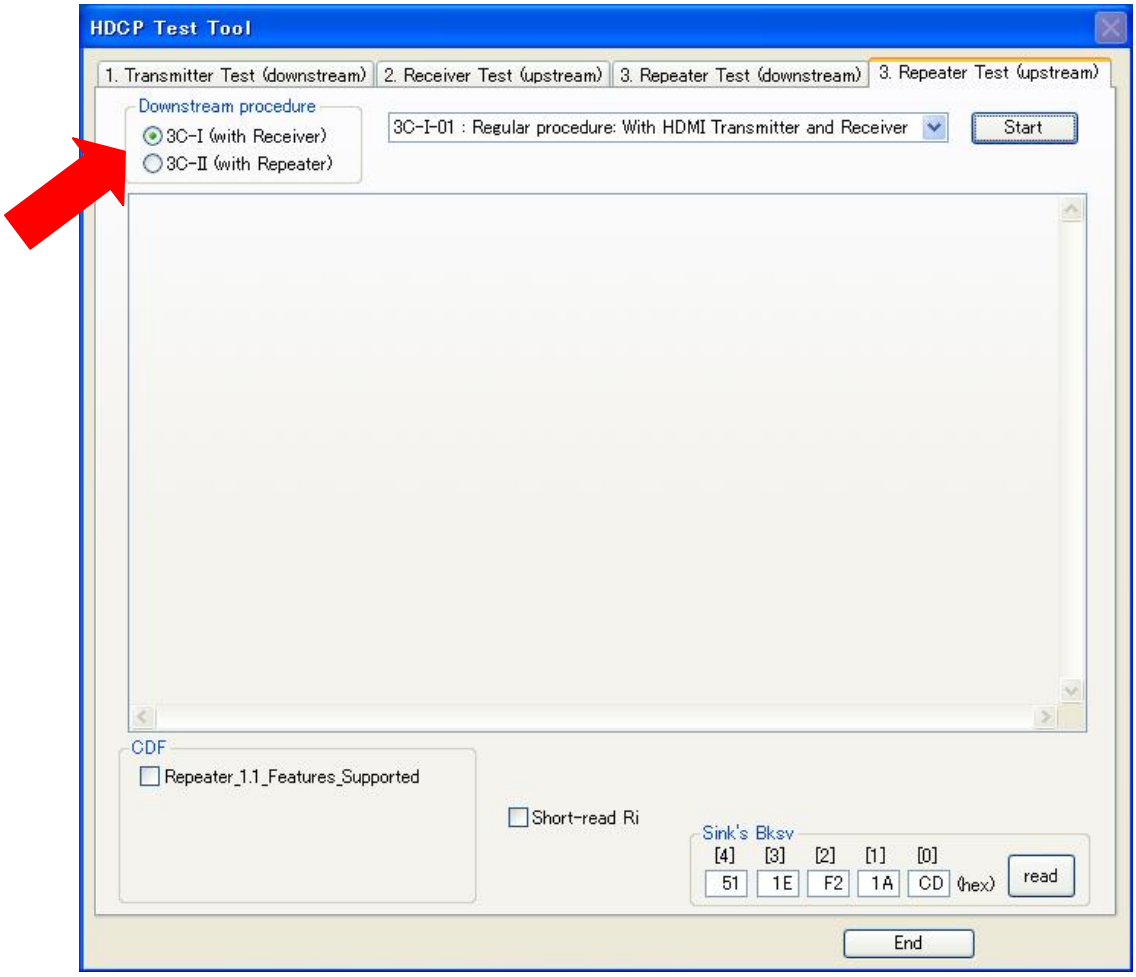
(10) Connect DUT to TE/Sink/Repeater (switching according to the test to perform) using HDMI cable. (Make sure to connect from "HDMI OUT" connecter of DUT to "HDMI IN" connecter of TE/Sink/Repeater)

Verification Test of the authentication procedure

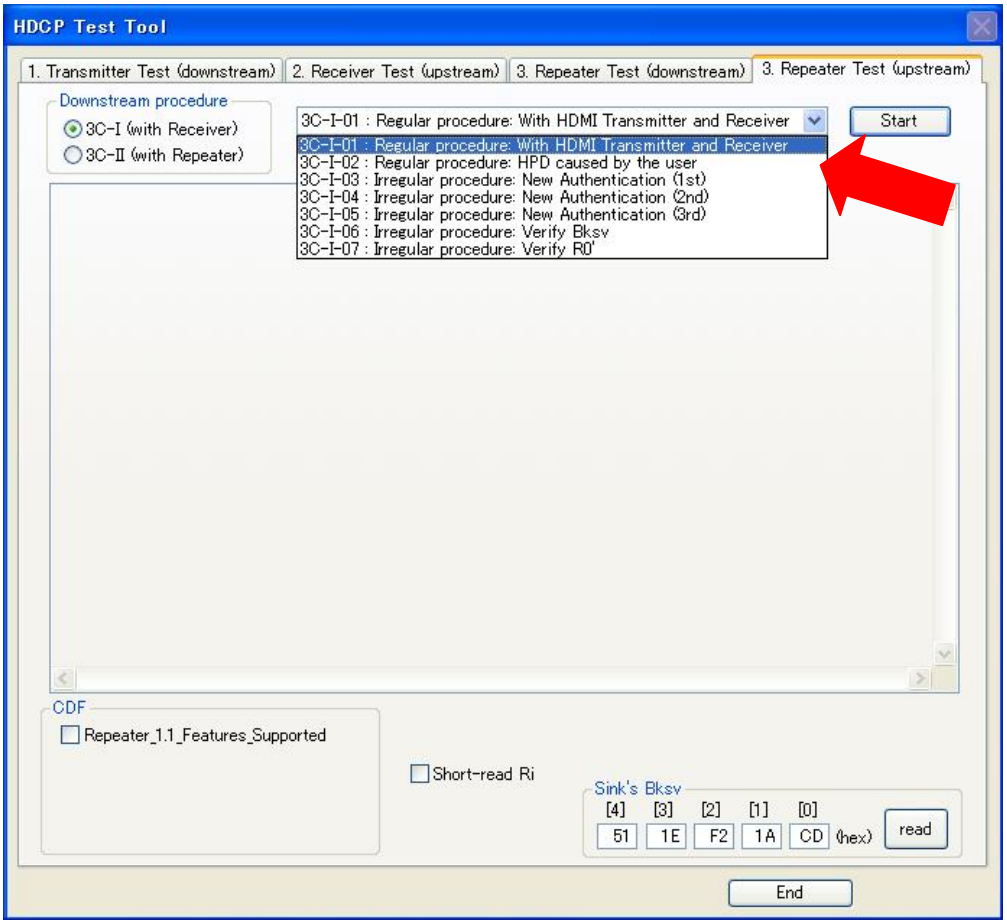
(11) Start 'HDCPTestTool.exe' by double-clicking it on PC and display "3. Repeater Test (upstream)" window.



(12) Select one of the functions of the tool as for “Downstream procedure”, “3C-I (with Receiver)” or “3C-II (with Repeater)”.

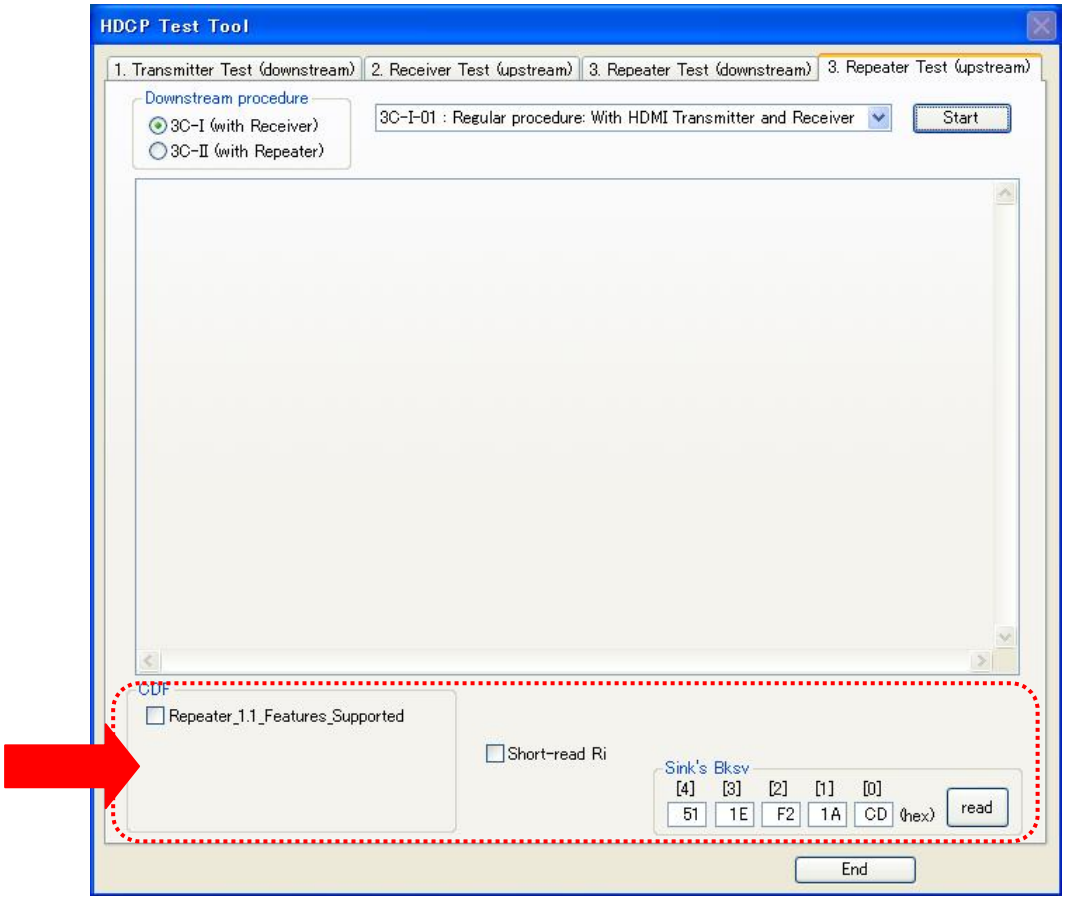


(13) Select the test item by selecting the corresponding test-ID.



(14) Input the necessary setting for the test.

The each test is performed on the basis of the information input by the operator.



Input Parameter list

Product Capability Parameter (PCP)

(a) Repeater_1.1Features_Supported = Does DUT support ADVANCED_CIPHER mode and Enhanced Link verification? If Yes, check this.

(b) Repeater_HDCP_HPD_signal = Does DUT have the capability to pulse HDCP_HPD by user operation? If Yes, check this.

(c) Repeater_Max_KSV = How many devices are supported by the size of the KSV FIFO of DUT? i.e. The size of KSV FIFO in bytes divided by 5 in the repeater from which the source will read. Not the size of KSV FIFO which the repeater can read. Input the number from 2 to 127.

(d) "Repeater_CP&EDID_HPD" = Does DUT provide HDMI support for CP&EDID_HPD signal as specified in the HDMI1.4 specification?

Note: The input of this parameter is disabled in HDCPTestTool.exe ver2.0.0.0X. Therefore "Repeater_CP&EDID_HPD" is always set to "No".

Others

If (d) "Repeater_CP&EDID_HPD" is checked, either of the following should be selected. Both test cases must be run. If (d) "Repeater_CP&EDID_HPD" is not checked, only (e) "Physical HPD line" can be selected.

(e) "Physical HPD line" = HDCP_HPD maps to physical HPD line.

(f) "CP&EDID HPD signal" = HDCP_HPD maps to CP&EDID signal.

Note: Since the input of "Repeater_CP&EDID_HPD" is disabled in HDCPTestTol.exe ver2.0.0.0X, "Physical HPD line" is always selected.

(g) Write Ainfo = Does TE sets ENABLE_1.1_FEATURES bit of Ainfo to one and perform Enhanced Link Verification? If Yes, check this.

- If (a) "Repeater_1.1Features_Supported" is checked, this can be set.

(h) Short-read Ri = How does TE read Ri in short-format or combined-format? If in short-format, check this.

(i) Sink's Bksv = If Sink is connected to DUT on downstream, read/input the value. (See [Sink's Bksv and Repeater's Bksv] described below)

(j) Repeater's Bksv = If Repeater is connected to DUT on downstream, read/input the value. (See [Sink's Bksv and Repeater's Bksv] described below)

O = Operator's input is needed

Test ID	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
3C-I-01	O	-	-	-	-	-	O	O	O	-
3C-I-02	O	O	-	-	-	-	-	-	O	-
3C-I-03	O	-	-	-	-	-	-	-	O	-
3C-I-04	O	-	-	-	-	-	-	-	O	-
3C-I-05	O	-	-	-	-	-	-	-	O	-
3C-I-06	O	-	-	-	-	-	-	-	-	-
3C-I-07	O	-	-	-	-	-	-	-	-	-
3C-II-01	O	-	O	-	-	-	O	O	O	O
3C-II-02	O	-	O	O	O	O	-	-	-	-
3C-II-03	O	-	O	O	O	O	-	-	-	-
3C-II-04	O	-	O	O	O	O	-	-	-	-
3C-II-05	O	-	O	-	-	-	-	-	-	-
3C-II-06	O	-	O	-	-	-	-	-	-	-
3C-II-07	O	-	O	-	-	-	-	-	-	-
3C-II-08	O	-	O	-	-	-	-	-	-	-
3C-II-09	O	-	O	-	-	-	-	-	-	-

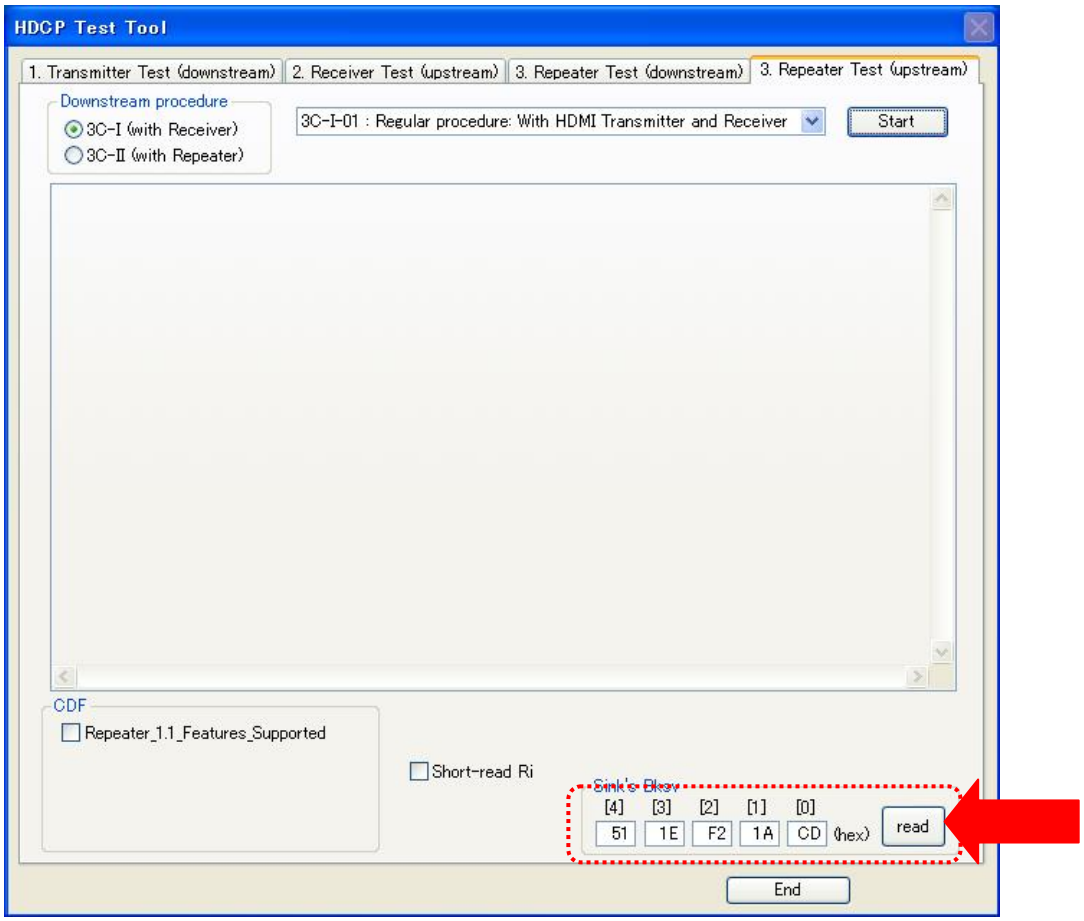
On the basis of value of (c) "Repeater_Max_KSV", TE as Pseudo-Repeater configures its setting of Bstatus:DEPTH and DEVICE_COUNT as follows:

Test ID	DEPTH	DEVICE_COUNT
3C-II-01	-	-
3C-II-02	1	1
3C-II-03	1	1
3C-II-04	1	1
3C-II-05	1	1
3C-II-06	5 or fewer	127 or fewer
3C-II-07	7	7
3C-II-08	1	1
3C-II-09	1	1

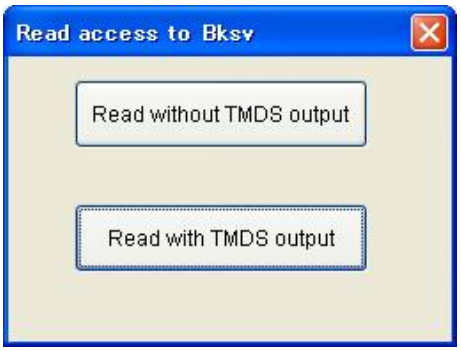
■ [Sink's Bksv and Repeater's Bksv]

If you know the attached Sink's/Repeater's Bksv, input the five bytes value of Bksv directly in [0] - [4] box in main dialog.

Otherwise, push "Read" button on the right-side and connect the Sink/Repeater to TE using HDMI cable. (NOTE: you need to connect TE and Sink/Repeater directly from "HDMI OUT" connecter of TE to "HDMI IN" connecter of Sink/Repeater)



When “Read access to Bksv” dialog is shown like the following,



- If DUT does not need video signal to make its HDCP port readable, then push “Read without TMDS output” button. DUT’s Bksv is read without TMDS output.
- If DUT needs video signal to make its HDCP port readable, then push “Read with TMDS output” button. First, the download of the TMDS data starts and DUT’s Bksv is read (retried, if necessary) with TMDS output.

If the read access succeeds, the five bytes value of DUT’s Bksv is displayed in [0] - [4] box in main dialog.

(15) Click “Start” button. Select/create the filename and folder to save the LOG and push “Save” button to continue.

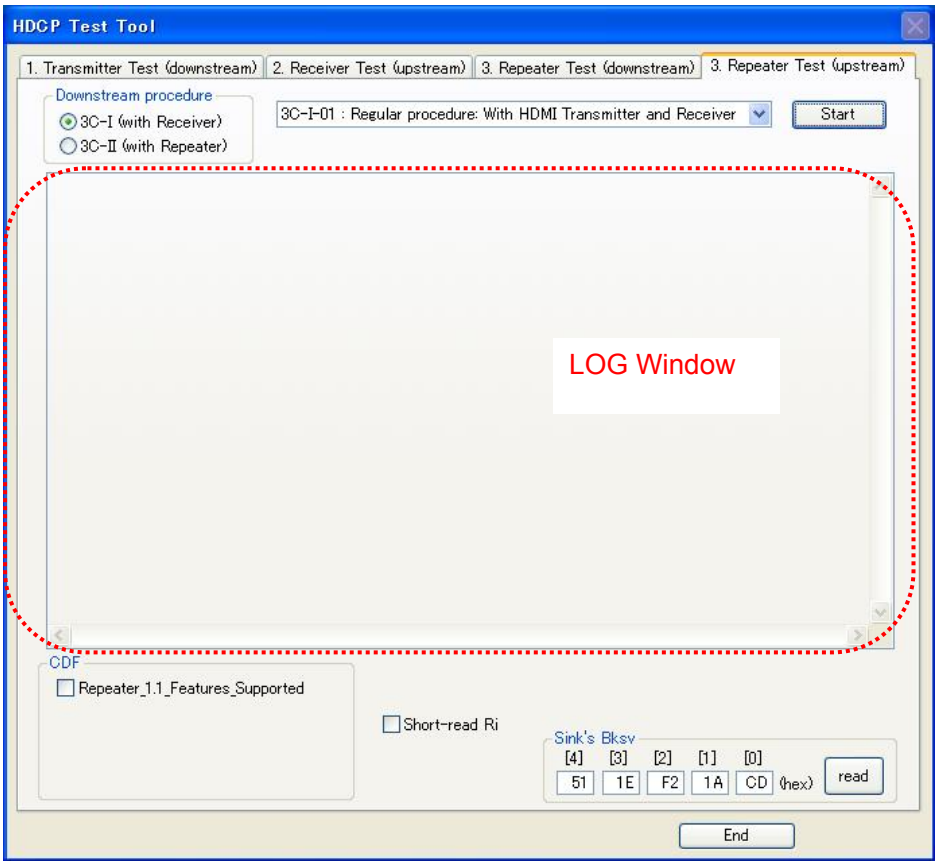
- **Before starting each test, make sure to unplug and plug HDMI connecter. It may be necessary for some DUT.**

(16) If the dialog to select the TMDS data to download is shown, select the corresponding data to the test. The download of the TMDS data starts.

- The download of TMDS data is performed only in the following case:
  - The first “Repeater Test (upstream)” after HDCPTestTool.exe is started.
  - The test using a different TMDS data was previously performed.
- DO NOT TURN OFF UITA-2000 if you want to use the same TMDS data as the one which the previously performed test used.
- Re-start “HDCPTestTool.exe” every time you want to download the TMDS data.

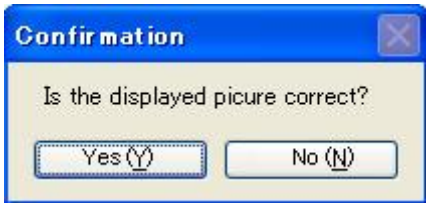
(17) Push “OK” button when the dialog like the following appears.

(18) The verification test starts and the LOG of the performed procedure is outputted in the LOG window. The same LOG is saved as the text file you named.



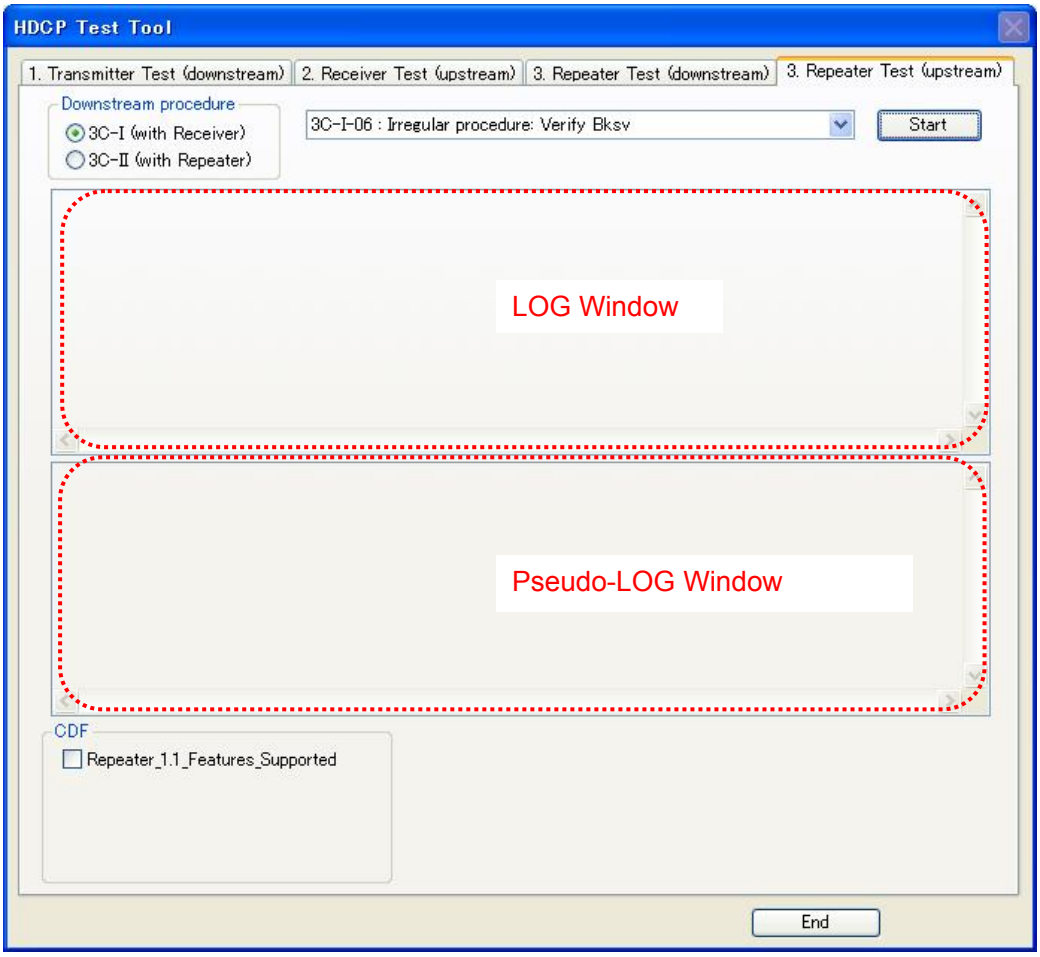
In the case of “3C-I-01”, “3C-I-03”, “3C-I-04”, “3C-I-05” and “3C-II-01” test, confirm the decrypted video (color bar) displayed on Sink device on your eyes and listen for tone from DUT/Sink while observing the video if DUT supports the audio output.

At the end of the test, the following Confirmation message dialog is shown. Answer the result of observing the decrypted video on Sink device while testing. The result of listening for tone should be included to this answer.



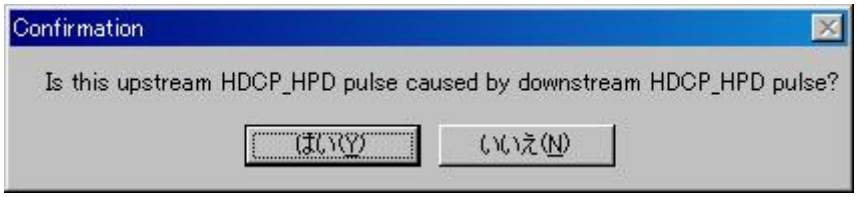
Even if the answer is “No” due to visual errors such as snow or listening errors such as no sound, this result alone is not considered “FAIL”. If there are errors in the authentication procedure, then the test result is “FAIL”.

In the case of “3C-I-06”, “3C-I-07”, “3C-II-02”, “3C-II-03”, “3C-II-04”, “3C-II-05”, “3C-II-06”, “3C-II-07”, “3C-II-08” and “3C-II-09” test, the LOG of the performed procedure with the Pseudo-Sink/Repeater is outputted in the Pseudo-LOG window. The same LOG is saved as the text file “[LOG filename] + Rx.txt”.



In the case of “3C-II-02”, “3C-II-03” and “3C-II-04” test, confirm whether DUT de-asserts and asserts HDCP_HPD to the upstream TE at the correct timing caused by the downstream Pseudo-Repeater’s HDCP_HPD pulse.

At the end of the test, the following Confirmation message dialog is shown.



UITA outputs the following message when DUT de-asserted HDCP_HPD.

"# DUT de-asserted HDCP_HPD (after No.*d*)"

No.*d* corresponds to the counter number of DDC access

If above No.*d* shows that DUT de-asserts HDCP_HPD after DUT reads R0(Ri) for the 3rd part of authentication (which is performed after Pseudo-Repeater de-asserted and asserted HDCP_HPD), by detecting mismatch of Ri on the downstream side, please answer “No”.

<u>The test Log sample in this case:</u>

Pease refer to the following:

(a) “# DUT de-asserted HDCP_HPD (after No.00048)” in log3C-II-02.txt

(b) Pseudo-Repeater de-asserted and asserted HDCP_HPD in log3C-II-02Rx.txt

(c) “00048: - 2174ms <- HDCP: 2B from 0x08 (R0') is read” in log3C-II-02Rx.txt

(c) shows that DUT detects mismatch of Ri after (b).

(a) shows that DUT de-asserted HDCP_HPD after this DDC access (c).

■ log3C-II-02.txt

```
------
(3C-II-02) 'Regular procedure: HDCP_HPD after writing Aksv' has started
Data Filename: TMDSdata3C_I_01.bin
00009: - -> read HDCP: 2B from 0x41 (Bstatus)
>> TE has started the output of TMDS
<< TE has detected TMDS signal
<< TE has detected VSYNC signal
00010: - 13ms -> read HDCP: 5B from 0x00 (Bksv)
00011: - 1ms -> read HDCP: 3B from 0x05 (Rsvd)
00012: - 1ms -> read HDCP: 5B from 0x0B (Rsvd)
00013: - 1ms -> read HDCP: 2B from 0x16 (Rsvd)
00014: - 3ms -> read HDCP: 12B from 0x34 (Rsvd)
00015: - 5ms -> read HDCP: 32B from 0x44 (Rsvd)
00016: - 6ms -> read HDCP: 32B from 0x64 (Rsvd)
00017: - 5ms -> read HDCP: 32B from 0x84 (Rsvd)
00018: - 4ms -> read HDCP: 28B from 0xA4 (Rsvd)
```

```
<< TE has detected HDMI signal
00019: - 481ms -> read HDCP: 2B from 0x41 (Bstatus)
00020: - 0ms -> read HDCP: 1B from 0x40 (Bcaps)
00021: - 1ms -> read HDCP: 5B from 0x00 (Bksv)
00022: - 3ms -> write HDCP: 8B from 0x18 (An)
00023: - 2ms -> write HDCP: 5B from 0x10 (Aksv)
The first part of authentication has started
00029: - 100ms -> read HDCP: 2B from 0x08 (R0')
00030: - 100ms -> read HDCP: 1B from 0x40 (Bcaps)
00033: - 100ms -> read HDCP: 1B from 0x40 (Bcaps)
00040: - 100ms -> read HDCP: 1B from 0x40 (Bcaps)
00041: - 0ms -> read HDCP: 2B from 0x41 (Bstatus)
00042: - 2ms -> read HDCP: 10B from 0x43 (KSV FIFO)
00043: - 6ms -> read HDCP: 4B from 0x20 (V'.H0)
00044: - 1ms -> read HDCP: 4B from 0x24 (V'.H1)
00045: - 1ms -> read HDCP: 4B from 0x28 (V'.H2)
00046: - 1ms -> read HDCP: 4B from 0x2C (V'.H3)
00047: - 1ms -> read HDCP: 4B from 0x30 (V'.H4)
HDCP encryption was enabled
The third part of authentication has started
# DUT de-asserted HDCP_HPD (after No.00048)   (a)
>> TE has stopped the output of TMDS
# DUT re-asserted HDCP_HPD
This test was completed
ERROR: 0 items
=======> PASS
```

■ log3C-II-02Rx.txt

```
>> Pseudo-Repeater has de-asserted HDCP_HPD
>> Pseudo-Repeater has asserted HDCP_HPD
00000: - <- HDCP: 5B from 0x00 (Bksv) is read
00001: - 4ms <- HDCP: 1B from 0x40 (Bcaps) is read
00002: - 16ms <- HDCP: 8B from 0x18 (An) is written
00003: - 4ms <- HDCP: 5B from 0x10 (Aksv) is written
The first part of authentication has started
00004: - 3ms <- HDCP: 5B from 0x00 (Bksv) is read
00005: - 0ms <- HDCP: 5B from 0x00 (Bksv) is read
00006: - 0ms <- HDCP: 5B from 0x00 (Bksv) is read
00007: - 0ms <- HDCP: 5B from 0x00 (Bksv) is read
00008: - 0ms <- HDCP: 5B from 0x00 (Bksv) is read
00024: - 3506ms <- HDCP: 5B from 0x00 (Bksv) is read
00025: - 4ms <- HDCP: 1B from 0x40 (Bcaps) is read
00026: - 16ms <- HDCP: 8B from 0x18 (An) is written
00027: - 4ms <- HDCP: 5B from 0x10 (Aksv) is written
The first part of authentication has started
>> Pseudo-Repeater has de-asserted HDCP_HPD   (b)
00028: - 3ms <- HDCP: 5B from 0x00 (Bksv) is read
>> Pseudo-Repeater has asserted HDCP_HPD
00031: - 225ms <- HDCP: 2B from 0x08 (R0') is read
00032: - 4ms <- HDCP: 1B from 0x40 (Bcaps) is read
00034: - 25ms <- HDCP: 1B from 0x40 (Bcaps) is read
```

```
00035: - 3ms <- HDCP: 2B from 0x41 (Bstatus) is read
00036: - 6ms <- HDCP: 5B from 0x43 (KSV FIFO) is read
00037: - 5ms <- HDCP: 2B from 0x41 (Bstatus) is read
00038: - 3ms <- HDCP: 2B from 0x41 (Bstatus) is read
00039: - 9ms <- HDCP: 20B from 0x20 (V'.H0) is read
00048: - 2174ms <- HDCP: 2B from 0x08 (R0') is read      (c)
Pseudo-Repeater function ended
```

If the answer is “No”, then the test result is FAIL.

LOG description

This is a sample LOG of “3C-I-01” test.

```
High-bandwidth Digital Content Protection System Compliance Test v1.2
Test ID: (3C-I-01) Regular procedure: With HDMI Transmitter and Receiver
Date: 2009/12/28
HDCPTestTool Version: 2. 0. 0. 00

------
Repeater_1.1Features_Supported = No
How to read Ri = Combined format access
Sink's Bksv = [0-4]: 0x63, 0x9A, 0x63, 0xE0, 0xBA

------
(3C-I-01) 'Regular procedure: With HDMI Transmitter and Receiver' has started

Data Filename: TMDSdata3C_I_01.bin

00000 -                 ->    read HDCP:    2B from 0x41 (Bstatus)
>>   TE has started the output of TMDS
<<   TE has detected TMDS signal
<<   TE has detected VSYNC signal
00001: -        12ms ->    read HDCP:    5B from 0x00 (Bksv)
00002: -         3ms ->    read HDCP:    3B from 0x05 (Rsvd)
00003: -         4ms ->    read HDCP:    5B from 0x0B (Rsvd)
00004: -         4ms ->    read HDCP:    2B from 0x16 (Rsvd)
00005: -         5ms ->    read HDCP:   12B from 0x34 (Rsvd)
00006: -         8ms ->    read HDCP:   32B from 0x44 (Rsvd)
00007: -         9ms ->    read HDCP:   32B from 0x64 (Rsvd)
00008: -         5ms ->    read HDCP:   32B from 0x84 (Rsvd)
00009: -         9ms ->    read HDCP:   28B from 0xA4 (Rsvd)
<<   TE has detected HDMI signal
00010: -       489ms ->    read HDCP:    2B from 0x41 (Bstatus)

00011: -        15ms ->    read HDCP:    1B from 0x40 (Bcaps)
00012: -         9ms ->    read HDCP:    5B from 0x00 (Bksv)
00013: -         9ms ->    write HDCP:   8B from 0x18 (An)
00014: -        10ms ->    write HDCP:   5B from 0x10 (Aksv)

The first part of authentication has started
00015: -       101ms ->    read HDCP:    2B from 0x08 (R0')
00016: -       100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00017: -        10ms ->    read HDCP:    2B from 0x41 (Bstatus)
00018: -         9ms ->    read HDCP:    5B from 0x43 (KSV FIFO)
00019: -        10ms ->    read HDCP:    4B from 0x20 (V'.H0)
00020: -        10ms ->    read HDCP:    4B from 0x24 (V'.H1)
00021: -         9ms ->    read HDCP:    4B from 0x28 (V'.H2)
00022: -        10ms ->    read HDCP:    4B from 0x2C (V'.H3)
00023: -         3ms ->    read HDCP:    4B from 0x30 (V'.H4)
```

User Input information

Sequential No. of HDCP access

(*1) This line means “Two bytes from offset address 0x41 of DUT’s HDCP register (i.e. it corresponds to Bstatus) is read by TE”

TE confirms HDMI_MODE bit of Bstatus == 0

This line means “Five bytes from offset address 0x00 of DUT’s HDCP register (i.e. it corresponds to Bksv) is read by TE after 12 ms from the previous HDCP port access (*1)”

TE confirms HDMI_MODE bit of Bstatus == 1

TE performs the first part of the authentication

TE performs the second part of the authentication

```
HDCP encryption was enabled
The third part of authentication has started
00024: -      2360ms ->    read HDCP:    2B from 0x08 (Ri')
00025: -      2133ms ->    read HDCP:    2B from 0x08 (Ri')
00026: -      2133ms ->    read HDCP:    2B from 0x08 (Ri')
00027: -      2133ms ->    read HDCP:    2B from 0x08 (Ri')
<<   TE has completed the output of TMDS
This test was completed
    ERROR: 0 items
    Displayed Picture: OK
 =======> PASS
```

TE performs the third part of the authentication

The number of errors of the verification test of the authentication procedure

The operator's input by viewing the displayed video on Sink device

This is a sample LOG of "3C-I-07" test.

```
High-bandwidth Digital Content Protection System Compliance Test v1.2
Test ID: (3C-I-07) Irregular procedure: Verify R0'
Date: 2009/12/28
HDCPTestTool Version: 2. 0. 0. 00

------
Repeater_1.1Features_Supported = No

------
(3C-I-07) 'Irregular procedure: Verify R0" has started

Data Filename: TMDSdata3C_I_01.bin

00000: -                ->    read HDCP:    2B from 0x41 (Bstatus)
>>   TE has started the output of TMDS
<<   TE has detected TMDS signal
<<   TE has detected VSYNC signal
00001: -        10ms ->    read HDCP:    5B from 0x00 (Bksv)
00002: -         9ms ->    read HDCP:    3B from 0x05 (Rsvd)
00003: -         5ms ->    read HDCP:    5B from 0x0B (Rsvd)
00004: -         5ms ->    read HDCP:    2B from 0x16 (Rsvd)
00005: -         4ms ->    read HDCP:   12B from 0x34 (Rsvd)
00006: -        10ms ->    read HDCP:   32B from 0x44 (Rsvd)
00007: -         9ms ->    read HDCP:   32B from 0x64 (Rsvd)
00008: -        10ms ->    read HDCP:   32B from 0x84 (Rsvd)
00009: -         9ms ->    read HDCP:   28B from 0xA4 (Rsvd)
<<   TE has detected HDMI signal
00010: -       486ms ->    read HDCP:    2B from 0x41 (Bstatus)

00011: -        10ms ->    read HDCP:    1B from 0x40 (Bcaps)
00012: -         6ms ->    read HDCP:    5B from 0x00 (Bksv)
00013: -         6ms ->    write HDCP:   8B from 0x18 (An)
00014: -         5ms ->    write HDCP:   5B from 0x10 (Aksv)

The first part of authentication has started
00021: -       101ms ->    read HDCP:    2B from 0x08 (R0')
00024: -       100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00025: -       100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00026: -       100ms ->    read HDCP:    1B from 0x40 (Bcaps)
```

```
00027: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)

HDCP encryption was enabled
The third part of authentication has started
00028: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00029: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00030: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00031: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00032: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00033: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00034: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00035: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00036: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00037: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00038: -        103ms ->    read HDCP:    1B from 0x40 (Bcaps)
00039: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00040: -        102ms ->    read HDCP:    1B from 0x40 (Bcaps)
00041: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00042: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00043: -        102ms ->    read HDCP:    1B from 0x40 (Bcaps)
00044: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00045: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00046: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00047: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00048: -        103ms ->    read HDCP:    1B from 0x40 (Bcaps)
00049: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00050: -        102ms ->    read HDCP:    1B from 0x40 (Bcaps)
00051: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00052: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00053: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00054: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00055: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00056: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00057: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00058: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00059: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00060: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00061: -        103ms ->    read HDCP:    1B from 0x40 (Bcaps)
00062: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00063: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00064: -        105ms ->    read HDCP:    1B from 0x40 (Bcaps)
00065: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00066: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00067: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00068: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00069: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00070: -        103ms ->    read HDCP:    1B from 0x40 (Bcaps)
00071: -        101ms ->    read HDCP:    1B from 0x40 (Bcaps)
00072: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
00073: -        100ms ->    read HDCP:    1B from 0x40 (Bcaps)
# 5 seconds passed after R0' was read
>>   TE has stopped the output of TMDS
This test was completed
    ERROR: 0 items
```

```
=======> PASS
```

This is a sample Pseudo-LOG of “3C-I-07” test.

```
>>   Pseudo-Sink has de-asserted HDCP_HPD
>>   Pseudo-Sink has asserted HDCP_HPD
00015: -              <-    HDCP:    5B from 0x00 (Bksv) is read
00016: -        1ms <-    HDCP:    5B from 0x00 (Bksv) is read
00017: -        1ms <-    HDCP:    1B from 0x40 (Bcaps) is read
00018: -        4ms <-    HDCP:    8B from 0x18 (An) is written
00019: -        1ms <-    HDCP:    5B from 0x10 (Aksv) is written

The first part of authentication has started
00020: -        1ms <-    HDCP:    5B from 0x00 (Bksv) is read
00022: -      104ms <-    HDCP:    2B from 0x08 (R0') is read
# DUT read (a part of) the invalid R0'
00023: -        1ms <-    HDCP:    2B from 0x08 (R0') is read
Pseudo-Sink function ended
```

DUT performs the first part of the authentication

Pseudo-Sink set invalid R0’ and DUT reads it

If the DUT accesses to HDCP port too fast too many times on downstream side (for example, 0ms or 1ms read loop in Pseudo-LOG), the output of HDCP access messages may be delayed and then the output order between HDCP access messages with the sequential No. and other messages without the sequential No. may be not synchronized relatively in Pseudo-LOG. The sequential No. of HDCP access may be also out of order relatively between on upstream and downstream side.

ERROR and WARNING is outputted like the following:

ERROR([error code]): [error content]

WARNING([warning code]): [warning content]

ERROR = DUT’s operation does not meet expectations and it is prohibited.

WARNING = DUT’s operation does not meet expectations but it is not treated as a failure.

If the verification test is completed with DUT, the tool outputs “PASS”/”FAIL” in the end of the LOG. If DUT responds to fall outside the programmed criteria, the tool outputs “NOT JUDGED” in the end of the LOG.

Note: If the field value of Bcaps of DUT is different from the expected value of UITA, the expected value of UITA is used for UITA’s calculation for R0/Ri/Pj.

For example:

- In “3C-I-01” test, if DUT sets Bcaps:REPEATER bit to zero, UITA calculates R0, Ri

(and Pj), assuming REPEATER bit as one and performs the second phase of authentication to this DUT.

Note: If the field value of Bstatus and KSV FIFO of DUT is different from the expected value of UITA, the field value of Bstatus and KSV FIFPO of DUT is used for UITA's calculation for V.

7. APPENDIX A - LOG Information -

- The time written for each DDC access in the LOG is the differential time in milliseconds from the previous access.
  * When TE (UITA-2000) performs as Rx function, it is the largest integer less than or equal to the values which was calculated by a16us counter in UITA-2000 hardware.
  * When TE (UITA-2000) performs as Tx function, it is the largest integer less than or equal to the values which was calculated by a high-resolution performance counter in PC system.

- In 1A-04/3A-02 Test, if DUT (Transmitter) completes a series of I^2C read sequence regardless of existence of ACK, UITA-2000 regards that the access of DDC happened twice and outputs LOG as so.

- The LOG message “[?] TE failed to perform DDC access” means that TE (UITA-2000) as Tx function failed to complete I^2C sequence. TE basically retries I^2C accesses 10 times while it is outputting TMDS data. However, in “3C-II-02”, “3C-II-03” and “3C-II-4” test, when TE reaches the state where there is a possibility DUT cause its HDCP_HPD pulse by physical line, TE will not retry I^2C access and just wait until test period passes.

- The LOG message “TE has detected TMDS signal” means that TE (UITA-2000) detected pixel clock of TMDS video format within the range from -15% of 25Hz to +15% of 27Hz. This message is not outputted on every video frame.

- The LOG message “TE has detected HDMI signal” means that TE (UITA-2000) detected Data Island in video frame. This message is not outputted on every video frame.

- The LOG message “TE has detected VSYNC signal” means that TE (UITA-2000) detected VSYNC Active edge in video frame. This message is not outputted on every video frame.

- The sequential No. of LOG message for DDC read/write is not assured to be correct. This is just to get a rough idea about the orders of DDC access which was performed in the upstream and downstream side of the DUT.